YITP Annual Report, Yukawa Institute for Theoretical Physics, Kyoto University 2008

YIITP Annual Report

Yukawa Institute For
Theoretical Physics
Kyoto University

2008

Foreword

We present here an annual report of the scientific activities of Yukawa Institute for Theoretical Physics during the academic year 2008.

First of all it is our great pleasure to report the 2008 Nobel physics prize awarded to our former director, Toshihide Maskawa for his contribution to the theory of CP violation. This is the 2nd Nobel prize given to the affiliates of our Institution. We consider that the award exemplifies the high standard of research conducted at our Institute and we would like to maintain our tradition of excellence in research in the future.

From the academic year 2007 we started our new project of "Yukawa International Program of Quark-Hadron Sciences (YIPQS)" funded by Japan Minsitry of Education, Culture and Sports. In this project we select a few research topics in each year and host long-term workshops extending over periods of a few months. We invite leading experts from the world in each topic and aim at fruitful collaboration among the workshop participants. In the year 2008, on top of two long-term workshops in the area of condensed matter theory and particle physics, several short-tem workshops were held. Our report contains some of the new developments initiated by these workshops.

Director
Tohru Eguchi

Contents

Chapter 1

People

5 January 2009

1.1 Regular Staff and Guest Professors (2008 April – 2009 March)

Regular Staff

Tohru Eguchi
Professor (E)

Taichiro Kugo
Professor (E)

Ken-ichi Shizuya
Professor (E)

Misao Sasaki
Professor (A)

Hisao Hayakawa
Professor (C)

Takami Tohyama
Professor (C)

Takahiro Tanaka
Professor (A) [2008.4.1 –]

Akira Ohnishi
Professor (N) [2008.4.1 –]

Masaru Shibata
Professor (A) [2009.1.1 –]

Ryu Sasaki
Associate Professor (E)

Masatoshi Murase
Associate Professor (C)

Hiroshi Kunitomo
Associate Professor (E)

Naoki Sasakura
Associate Professor (E)

Tetsuya Onogi
Associate Professor (E)

Keisuke Totsuka
Associate Professor (C)

Shigehiro Nagataki
Associate Professor (A)

Ken-iti Izawa
Associate Professor (E)

Yoshiko Kanada-Enyo
Associate Professor (N)

Kenji Fukushima
Associate Professor (N)

Kazuo Hosomichi
Associate Professor (E) [2009.1.1 –]

Takao Morinari
Research Associate (C)

Daisuke Jido
Research Associate (N)

Seiji Terashima
Research Associate (E)

Hirofumi Wada
Research Associate (C)

Yuko Fujita
Project Manager

In this list, the symbols A, C, E and N in the parenthesis are the following abbreviations of research fields:

A: Astrophysics and Cosmology
C: Condensed Matter and Statistical Physics
E: Elementary Particle Theory
N: Nuclear Physics Theory

Visiting Professors

Prof. Renata Kallosh
(Stanford University)
2008.4.1 — 2008.6.30
String theory, particle physics and cosmology

Prof. Andreas Schäfer
(Universität Regensburg)
2008.7.28 — 2008.10.18
Perturbative and non-perturbative aspects in QCD

Prof. Douglas Cameron Heggie
(The University of Edinburgh)
2008.9.1 — 2008.11.30
Dense stellar systems with massive black holes

Prof. Karlo Penc
(Research Institute for Solid State Physics and Optics)
2008.10.1 — 2008.12.31
Unconventionall ordered phases in spin systems

1.2 Research Fellows and Graduate Students (2008 April – 2009 March)

Research Fellows

Antonino Flachi (A) [2004.8.3 –]

Cecilia Albertsson (E) [2005.10.1 –]

Kimitake Hayasaki (A) [2006.4.1 – 2009.3.31]

Hiroyuki Abe (E) [2006.4.1 – 2008.10.31]

Tetsuji Kimura (E) [2006.10.1 – 2009.3.31]

Fabio Scardigli (A) [2006.10.2 – 2008.10.1]

Viktor Gabor Czinner (A) [2006.11.21 – 2008.11.20]

Keitaro Takahashi (A) [2007.4.1 – 2008.12.31]

Yuuiti Sendouda (A) [2007.4.1 –]

Seung-il Nam (N) [2007.4.1 – 2009.3.31]

Michio Ohtsuki (C) [2007.4.1 – 2008.9.30]

Etsuko Itou (E) [2007.4.1 – 2008.10.31]

Hideaki Iida (N) [2007.10.1 – 2009.3.31]

Toru Takahashi (N) [2007.10.1 –]

Masafumi Kurachi (E) [2007.10.1 – 2008.9.30]

Hiroyuki Fuji (E) [2007.10.1 – 2008.9.30]

Antonio Enea Romano (A) [2007.10.28 –]

Kotaro Miura (N) [2008.4.1 –]

Chul Moon Yoo (N) [2008.4.1 – 2008.8.31]

Takeshi Yamazaki (E) [2008.4.1 – 2008.12.31]

Nobuo Hinohara (N) [2008.4.1 – 2009.3.31]

Futoshi Yagi (E) [2008.4.1 –]

Shigetoshi Sota (C) [2008.4.1 –]

Frederico Arroja (A) [2008.10.31 –]

Norichika Sago (A) [2008.12.1 –]

Takashi Umeda (E) [2008.12.1 – 2009.3.31]

Eigo Shintani (E) [2009.2.1 – 2009.5.31]

Graduate Students

Takeshi Kuroiwa (C) [2008.4.1 –]

Kazuhiko Kamikado (N) [2008.4.1 –]

Manabu Sakai (E) [2008.4.1 –]

Shingo Mizuguchi (E) [2008.4.1 –]

Kazuya Misao (A) [2008.4.1 –]

Kei Yamamoto (A) [2008.4.1 – 2008.9.30]

Takahiro Himura (C) [2007.4.1 –]

Maiko Kohriki (E) [2007.4.1 –]

Takahiro Mimori (C) [2007.4.1 –]

Tatsuhiro Misumi (E) [2007.4.1 –]

Yuichiro Nakai (E) [2007.4.1 –]

Atsushi Naruko (A) [2007.4.1 –]

Kentaro Tanabe (A) [2007.4.1 –]

Kuniyasu Saitoh (C) [2008.4.1 –]

Junichi Aoi (A) [2006.4.1 –]

Masaki Murata (E) [2006.4.1 –]

Noriaki Ogawa (E) [2006.4.1 –]

Daisuke Yamauchi (A) [2006.4.1 –]

Hiroyuki Yoshidsumi (C) [2006.4.1 –]

Sugure Tanzawa (A) [2005.4.1 –]

Kohta Murase (A) [2005.4.1 –]

Hiroaki Ueda (C) [2005.4.1 –]

Mitsuhisa Ohta (E) [2005.4.1 –]

Chihiro Nakajima (C) [2007.4.1 –]

Yoshiharu Tanaka (A) [2004.4.1 – 2009.3.31]

Kazuya Mitsutani (N) [2004.4.1 – 2009.3.31]

Yuya Sasai (E) [2004.4.1 – 2009.3.31]

Michihisa Takeuchi (E) [2004.4.1 – 2009.3.31]

Takahiro Nishino (C) [2006.7.1 – 2009.3.31]

Tetsuya Mitsudo (C) [2006.7.1 –]

Atsushi Kawarada (C) [2006.7.1 –]

MEXT Foreign Research Students

Leonor García-Gutiérrez (E) [2008.4.1 –]

Youri Doeleman (A) [2008.4.1 –]

Ph.D Awarded

Takahiro Nishino
Field theoretical approach to glass transition (C)
(supervisor: Hisao Hayakawa)

Yuya Sasai
Noncommutative Field Theories and Hopf Algebraic Symmetries (E)
(supervisor: Naoki Sasakura)

Yoshiharu Tanaka
Gradient expansion approach to non-Gaussianity from inflation (A)
(supervisor: Misao Sasaki)

Michihisa Takeuchi
Measurements in hadronic channels at the LHC for physics beyond the Standard Model (E)
(supervisor: Ken-iti Izawa)

Chapter 2

Research Activities

2.1 Research Summary

Astrophysics and Cosmology Group

Non-Gaussianity from Inflation

T. Tanaka, with D. Langlois, S. Renaux-Petel, & D.A. Steer, studied Dirac-Born-Infeld (DBI) inflation models with multiple scalar fields. This is a model in which the brane motion in the extra-dimensions plays the role of the inflaton field. They showed that the adiabatic and entropy modes propagate with a common effective sound speed and are thus amplified at the sound horizon crossing. Before their work, it was erroneously thought that the entropy modes propagate at the speed of light. In the small sound speed limit, the amplitude of the entropy modes turn out to be much higher than that of the adiabatic modes, and therefore this could strongly affect the observable curvature power spectrum as well as the amplitude of non-Gaussianities, but interestingly their shape (momentum dependence) remains the same as in the single-field DBI case.

T. Tanaka, with S. Yokoyama & T. Suyama, also presented a new efficient method for computing the non-linearity parameters of the higher-order correlation functions of local type curvature perturbations in multi-component inflation models, focusing on the non-Gaussianity generated during the evolution on super-horizon scales. Explicit formulas obtained by applying their method were provided for up to five-point correlation functions as a demonstration of the powerfulness of the formalism. They also described how many parameters are needed to parameterize the amplitude and shape of the higher-order correlation functions of local type.

A. Naruko & M. Sasaki proposed a model of inflation, dubbed 'multi-brid inflation,' which predicts the level of non-Gaussianity that can be tested by near-future CMB anisotropy experiments such as Planck. An interesting aspect of this model is that the model may generate a detectable level of gravitational waves as well. This is in contrast to most of other models of inflation that predict large non-Gaussianity. Therefore, if the presence of both non-Gaussianity and gravitational waves is confirmed in the CMB anisotropy, it will provide strong evidence for multi-brid inflation.

Gravity in Brane World

T. Tanaka with K. Izumi studied the helicity-zero ghost (HZG) mode of massive graviton in the de Sitter background. In general, the presence of a ghost particle, which has negative energy, drives the vacuum to be unstable through pair production of ghost and ordinary particles. In the case that the vacuum state preserves the de Sitter invariance, the number density created by the pair production inevitably diverges due to unsuppressed ultraviolet contributions. In such cases, one can immediately conclude that the model is not viable. However, in the massive gravity theory one cannot construct a vacuum state which respects the de Sitter invariance. Therefore the presence of a ghost does not immediately mean the breakdown of the model. Explicitly estimating the number density and the energy density of particles created by the pair production of two conformal scalar particles and one HZG graviton, it is found that these densities both diverge. However, since models with HZG graviton have no de Sitter invariant vacuum state, it is rather natural to consider a UV cutoff scale in the three-dimensional momentum space. Then, even if the cutoff scale is chosen as large as the Planck scale, the created number density and energy density are well suppressed. In many models the cutoff scale is smaller than the Planck scale. In such models the created number density and the energy density are negligiblly small as long as only the physics below the cutoff scale is concerned. This shows that models with HZG, such as the self-acceleration branch of Dvali-Gabadadze-Porrati brane world model, may not be turned down because of the presence of a ghost.

A. Flachi & M. Minamitsuji studies the localization of scalar, fermion, and gauge field zero modes on a 3-brane that resides at the intersection of two 4-branes in six-dimensional anti-de Sitter space. It is found that zero modes can be localized only if masses and couplings to the background curvature satisfy certain relations. The case of bulk fermions is particularly interesting, since the properties of the geometry allow localization of chiral modes independently, thus obtaining chirality on the brane.

High-Dimension Numerical Relativity

Since a possibility of black hole (BH) formation in particle accelerators was pointed out, studies for BHs in higher-dimensional spacetimes have been accelerated. If our space is a 3-brane in large or warped extra dimensions, the Planck energy could be of $O(\mathrm{TeV})$ that may be accessible with huge particle accelerators like the Large Hadron Collider (LHC). In the presence of the extra dimensions, mini BHs may be produced in the accelerators and its evidence may be detected. Since BH formation is highly nonlinear gravitational phenomena, the unique method for clarifying the formation process and cross section for the BH formation is numerical relativity. M. Shibata with H. Yoshino implemented multi-purpose numerical relativity codes for a dimension larger than 5 for the first time. This year, they performed test simulations for validating this new codes.

Evaporating Black hole at Collider

A. Flachi, M. Sasaki, & T. Tanaka studied the evaporation of rotating mini black holes (BHs) produced in highly energetic particle collisions, taking into account the polarization due to the coupling between the spin of the emitted particles and the angular momentum of the BH. The effect of rotation shows up in the helicity dependent angular distribution significantly. By using this effect, there is a possibility to determine the axis of rotation for each BH formed. This helicity dependent angular distribution may provide a way to resolve the degeneracy among the parameters of the extra-dimension models.

Modified Gravity

Recent data of cosmological observations indicate that our universe has entered a stage of accelerated expansion. This accelerated expansion is usually attributed to the presence of finite vacuum energy, or more generally the so-called dark energy. However, it is possible that the accelerated expansion may be caused by modifications of gravity from Einstein theory at cosmological distances. To establish a framework of such modified gravity theories, M. Sasaki, & Y. Sendouda, with N. Deruelle, studied the so-called $f(R)$ gravity but with generalized coupling of matter to gravity.

Then motivated also by a widely accepted consequence of string theories, M. Sasaki, Y. Sendouda, & D. Yamauchi, with N. Deruelle, started to work on Hamiltonian formulations of modified theories of gravity whose Lagrangian is an arbitrary function of the Riemann curvature tensor, that is $f(\mathrm{R}iemann)$ gravity. The primary purpose of this study is to get insight of the *stringy* dynamics of a spacetime under certain extreme conditions. Through this work, it is found that there are a few distinctive classes of theories, each having specific degrees of freedom.

Cosmic Strings and CMB

K. Takahashi, A. Naruko, Y. Sendouda, D. Yamauchi, & M. Sasaki, together with C. Yoo, computed analytically the small-scale CMB temperature fluctuations from cosmic (super-)strings and studied the dependence on the string intercommuting probability P. The resultant PDF consists of a Gaussian part due to frequent scatterings by long string segments and a non-Gaussian tail due to close encounters with kinks. The dispersion of the Gaussian part is reasonably consistent with that obtained by numerical simulations. On the other hand, the non-Gaussian tail is found to contain two phenomenological parameters which are determined by comparison with the numerical results for $P = 1$. Extrapolating the pdf to the cases with $P < 1$, it is predicted that the non-Gaussian feature is suppressed for small P.

Gravitational Radiation Reaction

The study of the gravitational self force in the framework of the black hole perturbation is motivated by the requirement from the forthcoming gravitational wave observations that we prepare in advance a template bank of accurate waveforms. The gravitational self force on a particle orbiting a black hole can be calculated from the metric perturbation induced by the particle on the black hole spacetime. N. Sago & L. Barack developed a code to calculate the metric perturbation and the gravitational self-force in Schwarzschild spacetime. Also, as an application of their code, they estimated the self-force correction in the frequency of the inner most stable circular orbit in Schwarzschild geometry. This result may be a milestone in the study of the gravitational self force and comparison to other techniques like the post-Newtonian approximation and numerical relativity.

Double Neutron Star and Black hole-Neutron Star Binaries

The final phase of compact binary systems composed of neutron star (NS) and/or black hole (BH) is one of the most promising sources for grand-based laserinterferometric gravitational-wave detectors. The merger of NS-NS or BH-NS binaries is also proposed as a likely progenitor of the central engine of short gamma-ray bursts (GRBs). To accurately predict gravitational waveforms in the late inspiral and merger phases of these binaries, and also to clarify the merger process for investigating the merger hypothesis for the short GRBs, it is necessary to solve Einstein's equations as well as the hydro/magnetohydrodynamic equations taking into account a realistic microphysics for NSs. The unique theoretical approach to this issue is numerical relativity, in which all these equations are solved numerically. M. Shibata & K. Kyutoku, with K. Taniguchi, K. Kiuchi, Y. Sekiguchi & J. Friedman at UWM with his collaborators, performed numerical simulations for NS-NS and BH-NS binaries in the framework of numerical relativity changing mass and equations of state for a wide range, and obtained a variety of results. For NS-NS binaries, they clarified that (i) orbital angular frequency at the onset of the merger depends sensitively on the equations of state for NSs and is reflected clearly in the Fourier spectrum of gravitational waves, (ii) the waveforms in the case of BH formation have a universal feature and the formation process of the BH and surrounding disks is reflected in the Fourier spectrum, and (iii) the BH-disk system is formed only for the case that a large degree of asymmetry for NS's mass exist. For BH-NS binaries, they clarified that (i) orbital angular frequency at a time when a NS is tidally dirupted by the companion BH depends strongly on the equations of state for NSs, and (ii) the system composed of a BH and massive disk is formed only the case that the BH mass is rather small (less than $\sim 3M_{\odot}$). All these results indicate that gravitational-wave observation is a promising method for exploring the nature of NSs and physics of high-density nuclear matter as well as mechanism of short GRBs.

Collapse of Rotating Stars in GR

Massive stars of sufficiently high initial mass eventually collapses to a neutron star or a black hole (BH). In particular, the stars of the very large initial mass, $> 40M_{\odot}$, are believed to collapse to a BH. If the star has a large angular momentum, the resultsing system will be a Kerr BH surrounded by a massive disk. Such a system is proposed as the most promising candidate for the central engine of gamma-ray bursts (GRBs). One of the methods for theoretically clarifying this hypothesis is to perform numerical-relativity simulation for stellar collapse up through formation of the Kerr BH and surrounding disk, and to clarify whether the resulting system has appropriate properties for driving the GRBs. M. Shibata with Y. Sekiguchi developed a numerical-relativity code in which microphysical effects of high-density matter and neutrino cooling effects are incorpolated for the first time. They performed a first simulation for stellar collapse of very massive (Pop III) star to a BH and surrounding disk, and found that the disk is massive and high-temperature enough for emitting a large amount of high-energy neutrinos.

GRMHD Simulation for Collapsar

The mechanism of the central engine of long gamma-ray bursts (GRBs) is still unknown. One of the most promising scenarios of the GRBs is as follows: A fast rotating black hole or magnetar (neutron star with strong magnetic field) is born at the center of the massive star as a result of gravitational collapse, then a relativistic jet is launched from the compact object, and the jet is observed as a GRB. Since the system of the central region of massive stars and its dynamics are complicated, it is important and necessary to perform realistic numerical simulations by supercomputers for complete understanding of the mechanism of GRBs. In the simulation, strong gravitation and magnetic fields have to be treated properly. S. Nagataki has succeeded in developing a three-dimensional (3D) GRMHD code in the fixed Kerr spacetime that is tuned so that it is applicable to supercomputers.

Ultra-High Energy Cosmic Rays

Ultra-High Energy cosmic Rays (UHECRs), whose energy amounts to 10^{20}eV, are one of the most fascinating phenomena of Astronomy and Astrophysics. It is still unsolved where they are produced. Thus, the origin of UHECRs is one of the most fascinating mysteries of Astrophysics and Astronomy in 21st century. In order to shed light on the mystery, there have been many observational projects such as AGASA, HiRes, South Auger, and TA. They have reported energy spectrum, arrival distribution, and composition of UHECRs. Unfortunately, the origins of UHECRs are not determined. One of the reasons is that theoretical interpretation of the observations is not straight forward. In order to interpret and understand the observations, numerical simulations of propagation of UHECRs in the universe is essential. However, there has been no such a realistic, multi-dimensional simulation yet. Thus, Kotera, J. Aoi, K. Murase, and S. Nagataki are developing such a numerical code. They studied the propagation of UHE-Nuclei in a cluster of galaxies with a team in France. It is more difficult to treat nuclei rather than protons, because nuclei have many channels of photo-dissociation. They found that the survival of heavy nuclei highly depends on the injection position and on the profile of the magnetic field. Taking into account the limited lifetime of the central source could also lead in some cases to the detection of a cosmic ray afterglow, temporally decorrelated from neutrino and gamma ray emissions. They calculated that the diffusive neutrino flux around 1 PeV coming from clusters of galaxies may have a chance to be detected by current instruments. The observation of single sources in neutrinos and in gamma rays produced by ultrahigh energy cosmic rays will be more difficult. Signals coming from lower energy cosmic rays ($E \leq 1$PeV), if they exist, might however be detected by Fermi, for reasonable sets of parameters.

Blandford-Znajek Effects

The Blandford-Znajek mechanism, by which the rotational energy of a black hole (BH), is extracted through electromagnetic fields, is one of the promising candidates for an essential process of the central engine of active compact objects such as gamma-ray bursts. The only known analytical solution of this mechanism is the perturbative monopole solution on the Kerr spacetime up to the second order terms in the spin parameter. To understand the Blandford-Znajek mechanism for rapidly rotating BHs, K. Tanabe and S. Nagataki tried to obtain the perturbation solution up to the fourth-order in spin. They found that the fourth-order terms of the vector potential diverge at infinity, implying that the perturbation approach breaks down at a large distance from the BH.

Condensed Matter and Statistical Dynamics Group

Advanced Statistical Dynamics

The subjects of advanced statistical dynamics are nonequilibrium statistical mechanics, nonlinear sciences and biological physics. The main goal in this field is to understand how dynamical nonequilibrium structures are sustained in nature based on tools of statistical physics. Thus, the research areas are spread in variety of fields in social sciences, biology, chemisty, engineering, mathematics and physics. The current research activities of this group include nanophysics, granular physics, nonlinear rheology in glassy materials, biomechanics, and system biology. This academic year, Hayakawa chaired an international symposim “Frontiers of Glassy Physics” and Murase organized a workshop “What is Life? The Next 100 Years of Yukawa’s Dream.”

Collision of nanoclusters subject to thermal fluctuations:

There are small number of atoms in nanoclusters in which the concepts of thermodynamics are no longer valid. Such small systems are strongly affected by thermal fluctuations, and counter-intuitive physical processes can be observed. Kuninaka and Hayakawa investigated head on collisions between identical nanoclusters, and found that the probability of the restitution coefficient to exceed unity is considerably high, though the averaged behavior can be explained by a theory based on continuum mechanics. They also gave an explanation of such probability based on a simple phenomenology. Their paper has been introduced in many media such as Phys. Rev. Focus, Science News, Nature Nanotechnology, Tokyo Newspaper and Chunichi Newspaper etc.

Jamming transition for sheared granular materials:

Jamming transition is an athermal and a rigidity transition. This is one of the common concepts in dense materials, but Otsuki and Hayakawa analyzed the jamming transition of granular materials. What they found is the existence of a universal scaling law for the jamming transition of frictionless granular materials. They developed a mean-field theory and checked its validity by the comparison with extensive molecular dynamics simulation. Their theory seems to be very accurate, and both authors have been invited to present a talk in many occasions.

Long-range correlations for sheared liquids:

Sheared dense liquids approach nonequilibrium steady states under the balance of viscous heating and dissipations. These systems exhibit some differences from systems at equilibrium. One of the characteristics of such systems are the existence of the long-range correlations. Based on fluctuating hydrodynamics, Otsuki and Hayakawa discussed how the long-range correlations appear in dense sheared systems such as granular materials, and confirmed the existence of the long-range correlations. The validity of their theory has been confirmed by their extensive simulation.

Field theory of glass transition:

Physics of glass transition has a long history, but there is no satisfactory theory to explain the glass transition. One of the main concerns is how to remove the artifacts of the ergodic-nonergodic transition (ENT) without using phenomenology. Nishino and Hayakawa developed a field theory which satisfies fluctuation-dissipation relations in order by order of perturbations. They began with fluctuating hydrodynamics, and derived a known mode-coupling equation, which has ENT. They still do not succeed to remove ENT, but one important step is achieved toward understanding physics of glass transition.

Nonlinear and non-equilibrium dynamics of elastic objects driven in a viscous fluid:

Nonlinear and non-equilibrium dynamics of elastic objects driven in a viscous fluid constitutes now an important research area in Microfluid mechanics and Soft-matter physics. While part of the motivation goes to progress in microfluidics applications, understanding detailed fluid-structure interactions also offers a challenging problem in non-equilbirium statistical physics. Using elasto-hydrohydrodynamic simulations and scaling arguments, Wada studied the non-equilibrium dynamics of a rotating elastic nano-ring driven in a Stokes fluid by an externally applied torque. He showed that a helical deformation of the ring filament is excited, and that this leads to directed propulsion even in zero Reynolds number limit, independent of the direction of rotation. It is found that the propulsive force and efficiency initially increase as the torque increases, and then decrease discontinuously at a buckling transition into a twisted shape at a critical torque. This unique propulsive behavior at the shape transition arises due to its specific geometry, i.e., circularity of an elastic filament. Since nano-sized elastic rods of desired shape and stiffness can be now manufactured in laboratories, the implications of these behavior for artificial microscopic devices are also investigated.

Towards construction of a life theory:

On the basis of the complementarity idea, a holistic view was introduced by integrating fragments of knowledge at various component levels. As a living organism is engaged in challenges from both its internal and external environments, it encounters unlimited conflicts and oppositions, which in turn must be the driving force for its evolution and development. It is such reconstructive dynamics that can give rise to an identity of the living organism. The resultant identity of life was represented by an emergent symbol generated by the process of endo-exo circulation. Following the international symposium on “ What is Life? The Next 100 Years of Yukawa’s Dream, ” Murase edited the proceedings through Progress of Theoretical Physics as a Supplement No. 173. Almost 30 papers were included in the interdisciplinary fields from molecular biology to theoretical physics.

Condensed-Matter Physics

The subjects of condensed-matter physics are the states of matter that emerge at low-temperatures as a consequence of non-trivial many-body effects. The main goal in this field is to understand how interplay among such low-energy degrees of freedom as charge, spin and (electron) orbital, when combined with a few simple fundamental principles (e.g. Fermi statistics, electromagnetic force), leads to a variety of phenomena. The area of current research in this group includes dynamical properties of strongly-correlated electron systems, mechanism of high-temperature superconductivity, transport properties of organic compounds, exotic phenomena in low-dimensional quantum magnetism.

Low-temperature density matrix renormalization group using regulated polynomial expansion: The density matrix renormalization group (DMRG) method is a powerful numerical technique to investigate various properties of low-dimensional strongly correlated electron systems. However, at low-temperatures, it is difficult to obtain physical quantities by the current finite-temperature DMRG methods. Sota and Tohyama proposed a new DMRG technique at finite temperatures. A single-target state appropriate for finite-temperature is calculated by making use of a regulated polynomial expansion. Both static and dynamical quantities are obtained after a random-sampling and averaging procedure. This technique was applied to the one-dimensional Hubbard model at half filling, and it was found that this gives excellent results at low temperatures.

Enhancement of phonon effects in photoexcited states of one-dimensional Mott insulators: Tohyama and his collaborators examined how the electron correlation affects the electron-phonon interaction in the linear optical absorption spectrum of the one-dimensional extended Hubbard-Holstein model. A density matrix renormalization group (DMRG) calculation showed that the effect of the electron-phonon interaction on an exciton is enhanced by increasing the on-site Coulomb repulsion. The DMRG data with the electron-phonon interaction fit with absorption experiments in one-dimensional cuprates better than those for the extended Hubbard model.

Origin of the spatial variation of the pairing gap in Bi-based high-temperature cuprate superconductors: Recently, scanning tunneling microscopy on the Bi-2212 cuprate superconductor has revealed a spatial variation of the energy gap that is directly correlated with a modulation of the apical oxygen position. Tohyama and his collaborators identified two mechanisms by which out-of-plane oxygens can modulate the pairing interaction within the Cu-O plane: a covalency between the in-plane band and apical orbital, and a screening of on-site correlation by apical oxygen polarization. Both effects strongly depend on the apical oxygen position, and their cooperative action explains the experiment.

Dynamical mass generation in undoped high-temperature superconductors: In the phase diagram of the high-temperature superconductors, the most established phases are arguably the d-wave superconducting phase and the Néel-ordered phase. One of the key questions about high-temperature superconductivity is how to connect these two phases. If one starts from the Néel-ordered state toward the d-wave superconducting state, the first step would be to consider a system with a single hole doped. Experimentally, such a system has been studied by angle-resolved photoemission spectroscopy in the undoped compounds where a photo-hole is introduced in the system and the excitation spectrum is associated with the properties of the single-hole-doped system. The experimentally obtained excitation spectrum is in qualitatively good agreement with the quasiparticle excitation spectrum of the π-flux mean-field state with a mass term. However, the origin of the mass term has not been clarified so far. Morinari showed that fluctuations about the π-flux mean-field state lead to the dynamical mass generation. The formulation does not require any additional repulsive interaction discussed in the literature. The dynamical mass is associated with the interaction mediated by the Lagrange multiplier field, which is introduced to suppress double occupancy. A self-consistent picture about the mass generation and the propagation of the Lagrange multiplier field without damping was proposed. The theory suggests a natural framework to study spin disordered systems in which fermionic excitations are low-lying excitations.

Interlayer magnetoresistance in layered Dirac electron systems: In condensed matter systems, it is possible to realize a massless Dirac-fermion-like excitation spectrum of electrons with the speed of light being replaced by the Fermi velocity. Since the discovery of unconventional integer quantum Hall effect in graphene, which is a two-dimensional carbon material with a honeycomb lattice, Dirac fermions realized in condensed matter systems have attracted much attention. A layered organic compound α-(BEDT-TTF)$_2$I$_3$ under pressure exhibits anomalous properties which are consistent with a Dirac fermion excitation spectrum. (Here BEDT-TTF denotes bis(ethylenedithio)-tetrathiafulvalence.) Theoretically, it has been predicted that the Dirac cone characterizing the Dirac fermion spectrum in this system is tilted. Morinari, Himura, and Tohyama proposed that the presence of a tilted Dirac cone can be verified using the interlayer magnetoresistance. Theoretical formula for the interlayer magnetoresistance was derived using the analytic Landau-level wave functions and assuming local tunneling of electrons. It was shown that as a function of the azimuthal angle of the magnetic field the resistivity takes the maximum in the direction of the tilt.

Magnetic structure in quantum helimagnets: In a class of frustrated magnets, the existence of competing interactions stabilizes various non-collinear structures. Classical helimagnets, which have been extensively studied in 1960s, are typical examples of those systems. Quite recently, however, quantum helimagnets attract renewed interests since the discovery of a series of multiferroic compounds as the helimagnetic structure is expected to induce (macroscopic) electric polarization. The external magnetic field can control the bulk polarization by changing the magnetic structure and, for this reason, it would be interesting to investigate the high-field magnetic structure of quantum helimagnets in an unbiased manner. Ueda and Totsuka considered a model of three-dimensional quantum helimagnets by using the dilute-Bose-gas technique and mapped out the phase diagram in high fields. It was shown that, in addition to the cone phase which exists already in the classical phase diagram, two new quantum phases ('fan' and 'spin-nematic') appear.

Spin supersolids on body-centered cubic (bcc) lattice: The analogy between quantum spin systems and lattice boson systems has been used extensively since the pioneering work of Matsubara and Matsuda. In 1970s, on the basis of this analogy and a subsequent mean-field approximation, it was predicted that a phase, where superfluid (off-diagonal) long-range order and (diagonal) order in the boson density coexist (i.e. supersolid), may be realized in ^{4}He. In order to see how quantum fluctuations affect the above mean-field results, Ueda and Totsuka investigated anisotropic spin-S systems on a bcc lattice by using the dilute-Bose-gas approximation combined with the $1/S$-expansion.

Genuine spin liquid states in high magnetic fields: Normally, magnetic systems eventually assume a certain kind of ordered states (e.g. magnetic, spin-Peierls, etc.) at very low temperatures. Nevertheless, featureless spin liquids, if exist, may be quite interesting since various unusual properties–fractionalized excitations, topological order, etc.–are expected. In this sense, genuine (gapped) spin liquids which do not have any kind of local order even at zero temperature, is a 'holy grail' in condensed matter physics. It is well-known that when the external magnetic field is applied, magnetic systems may form gapped states (*magnetization plateaus*) at rational values of magnetization (per unit cell) m. A flux-insertion argument similar to that used by Laughlin only predicts plateaus with broken translational symmetry when $(S-m) \neq$integer. To see whether or not there exists a possibility of featureless spin liquid plateaus, Tanaka, Totsuka and Hu tackled this problem by using an effective field theory and found that, when $(S-m) =$integer$+1/N$, spin-liquid plateaus, whose non-magnetic sector is described by Z_N gauge theory, are allowed.

Nuclear Theory Group

The main focus of this research group is the basic investigation of nuclear physics covering all the physical phenomena governed by the strong interactions, such as the structure and the dynamics of nuclei and hadrons, and properties of hadron-quark many-body system in finite temperatures and densities. Here is a brief review of the research activity of this group in the academic year of 2008.

Nuclear structure and reaction

The goal of nuclear structure physics is to construct a unified microscopic comprehension of nuclear properties by solving nuclear many-body systems. Recently, various new phenomena have been discovered in a region of unstable nuclei far from the stability line due to the progress of experimental facilities such as the RI beam factory. In theoretical studies of nuclear structure, it is desired to understand these phenomena of exotic nuclei and to provide theoretical predictions.

For the research of the large-amplitude collective motion in nuclei, Hinohara and collaborators investigated the oblate-prolate shape coexistence phenomena observed in proton-rich ^{68,70,72}Se using the adiabatic self-consistent collective coordinate (ASCC) method. They extracted the one-dimensional collective degree of freedom which connects the oblate and prolate mean-fields, and discussed the shape mixing dynamics in low-lying states. Hinohara and Kanada-En'yo studied the low-lying states of light Mg isotopes. The calculation by the ASCC method showed the extremely γ-soft character of the nuclei. It was indicated that the neutron or proton isovector contributions are dominant in some intra-band E2 electric transitions, and the relation to the large-amplitude triaxial dynamics was discussed.

For light-weight nuclei, Kanada-En'yo and her collaborators performed systematic study of deformation and clustering in $Z = N =$even nuclei in the *sd*-shell region by using a method of the deformed-basis AMD. It was found that the deformations in this mass number region often involve cluster structures. They also studied the ground and excited states of very-light nuclei such as He and C isotopes with the AMD method and suggested possible appearance of various cluster states in excited states.

One of the hot subjects concerning the neutron-rich nuclei near the drip line is "dineutron correlations" which are the strong spatial correlations between two neutrons coupling to spin zero. The dineutron correlation in ideal 2-dimensional neutron matter systems has been studied by Kanada-En'yo, Hinohara and their collaborators, and its relation to neutron skin structure has been discussed. It is interesting that the dineutron pair wave function changes drastically as a function of neutron density, namely, the system shows the transition from strong coupling regime to weak coupling one with the increase of neutron density.

Hadron structure and dynamics

Pseudoscalar-meson–Octet-baryon coupling constants and axial charges from lattice QCD: Meson-Baryon coupling constants are of great importance, since baryons are main building blocks in our world and their interactions are produced by meson exchanges. The corresponding baryon axial charges are also significant parameters reflecting the structures of baryon sector, which should be evaluated based on the underlying theory, Quantum ChromoDynamics (QCD). T.T. Takahashi, in collaboration with G. Erkol and M. Oka, extracted πNN, $\pi\Sigma\Sigma$, $\pi\Lambda\Sigma$, $K\Lambda N$, $K\Sigma N$, $\pi\Xi\Xi$, $K\Sigma\Xi$, and $K\Lambda\Xi$ coupling constants and the corresponding axial charges using lattice QCD with two flavors of dynamical quarks. The parameter $\alpha \equiv F/(F+D)$ representing the SU(3)-flavor symmetry was computed in the SU(3) limit where the three quark flavors degenerate at the physical *s*-quark mass. It was found to be $\alpha \sim 0.395$ in the SU(3) limit, which is close to 2/5, the prediction from the SU(6) quark model. The quark-mass dependences of the coupling constants as well as the axial charges were also obtained by changing the *u*- and the *d*-quark masses. They finally found that the SU(3)-flavor relations are broken by only a few percent in the quark-mass range they considered ($35 \sim m_{ud} \sim 150$ MeV).

Kaonic production of $\Lambda(1405)$ *off deuteron target in chiral dynamics*: Jido in collaboration with Oset and Sekihara investigated the K^- induced production of $\Lambda(1405)$ in $K^-d \to \pi\Sigma n$ reactions based on coupled-channels chiral dynamics, in order to determine the resonance position of the $\Lambda(1405)$ in the $\bar{K}N$ channel. They found that the $K^-d \to \Lambda(1405)n$ process favors the production of $\Lambda(1405)$ initiated by the $\bar{K}N$ channel. Their approach indicated that the $\Lambda(1405)$ resonance position is 1420 MeV rather than 1405 MeV in the $\pi\Sigma$ invariant mass spectra of $K^-d \to \pi\Sigma n$ reactions. This is consistent with an observed spectrum of the $K^-d \to \pi^+\Sigma^- n$ with 686-844 MeV/c incident K^- by bubble chamber experiments done in the 70's. Their model also reproduced the measured $\Lambda(1405)$ production cross section.

K^-pp system with chiral SU(3) effective interaction: Hyodo and his collaborators investigated the K^-pp system using a variational approach with realistic two-body interactions: the Argonne v18 *NN* potential and an energy dependent $\bar{K}N$ effective interaction derived from chiral SU(3) coupled-channel dynamics. The energy dependence of the $\bar{K}N$ interaction is self-consistently taken into account. Uncertainties in subthreshold extrapolations of the $\bar{K}N$ interaction are considered, based on four different chiral models for the effective $\bar{K}N$ interaction and two assignments of the two-body energy of the $\bar{K}N$ system in the K^-pp. In all cases studied, a weakly bound K^-pp state is found, with a binding energy $B = (19 \pm 3)$ MeV, which is substantially smaller than suggested in previous phe-

nomenological calculations. The mesonic decay width $\Gamma(K^- pp \to \pi\Sigma N)$ is estimated to range between about 40 and 70 MeV.

Hadronic molecular states with two kaons: Jido and Kanada-En'yo investigated hadronic molecule states with two kaons, such as $K\bar{K}N$ and $\bar{K}\bar{K}N$ systems with $I = 1/2$ and $J^P = 1/2^+$. They started with an assumption that the $\Lambda(1405)$ resonance and the scalar mesons, $f_0(980)$, $a_0(980)$, are reproduced as quasi-bound states of $\bar{K}N$ and $K\bar{K}$, respectively. Performing non-relativistic three-body calculations with a variational method for this system, they found a quasibound state of the $K\bar{K}N$ system around 1910 MeV, which is below the three-body breakup threshold. This state corresponds to a new baryon resonance of N^* with $J^P = 1/2^+$. They found also that this resonance has the cluster structure of the two-body bound states keeping their properties as in the isolated two-particle systems. The $\bar{K}\bar{K}N$ system was also investigated in the same formulation and it was found that this system could form a bound state, which corresponds to a Ξ^* resonance with as small binding energy as a few MeV.

Pion electromagnetic charge radii and ρ-meson mass shift at finite density: The pion electromagnetic charge radii and mass dropping of the ρ meson at finite density were investigated by Nam and his collaborator. They first calculated the pion charge radii within the framework of the nonlocal chiral quark model from the instanton vacuum both at zero and finite densities. In order to relate the change of the pion charge radius to that of the ρ-meson mass at finite density, they employed the vector-meson dominance for the pion electromagnetic form factor. It turned out that the pion charge radius was getting larger as the quark chemical potential increased. As a result, the rho-meson mass fell off as the quark chemical potential grew and was found to be dropped by about 10 % at normal nuclear matter density: $m^*_\rho/m_\rho \sim 1 - 0.12\,\mu_B/\mu_0$, which was compatible to the results of the measurement at the KEK recently.

Pion weak decay constant at finite density from the instanton vacuum: Nam and his collaborator studied the pion weak decay constant (F_π) and pion mass (m_π) at finite density within the framework of the nonlocal chiral quark model from the instanton vacuum with the finite quark-number chemical potential (μ) taken into account. They mainly focused on the Nambu-Goldstone phase below the critical value of the chemical potential μ_c. The breakdown of Lorentz invariance at finite density being considered, the time (F^t_π) and space (F^s_π) components were computed separately, and the corresponding results turned out to be: $F^t_\pi = 82.96$ MeV and $F^s_\pi = 80.29$ MeV at μ_c, respectively. Using the in-medium Gell-Mann-Oakes-Renner (GOR) relation, they showed that the pion mass increases by about 15% at μ_c.

Valence-quark effect to heavy-quark potential: Heavy-quark potential is the key ingredient for studying color confinement and the structure of hadrons. The effect of dynamical quarks (sea quarks) to the heavy-quark potential has been frequently investigated in lattice QCD. However, the effect of light valence quarks is still not known. Yamamoto, Iida, and Suganuma study heavy-heavy-light quark (QQq) systems to investigate the effect of light valence quarks on heavy-quark potential by using lattice QCD. They calculate the energy of QQq systems as the function of distance R between two heavy-quarks. They find that the QQq potential is well described by a Coulomb plus linear potential form up to the intermediate distance $R \leq 0.8$fm. As a remarkable fact, compared to the static three-quark case, the effective string tension between the two heavy-quarks is significantly reduced by the light valence quark effect. Namely, the valence quark screens the interquark potential between two heavy-quarks. Such a reduction would be a general property for baryons.

Quark distributions in nucleons and nuclei: Yazaki in collaboration with Bentz, Cloet, Ito and Thomas studied the medium modifications of quark distributions and structure functions in the framework of a chiral effective quark theory. Particular emphasis was put on the isospin dependence of the in-medium quark distributions. As an interesting application, they discussed a possible solution of the so-called NuTeV anomaly. Possible extensions of the model to describe fragmentation functions were also discussed.

Equation of state of hyperon mixed supernova matter, and its application to black hole formation: In nuclear matter at high densities, hadrons with strangeness are expected to emerge and they may affect the compact astrophysical processes. Ohnishi and collaborators discussed the properties of supernova matter equation of state (EOS) including hyperons, and the emergence of hyperons in dynamical core-collapse processes. Hyperonic EOS was constructed based on an $SU_f(3)$ relativistic mean field model together with the recently suggested hyperon potentials, which are less attractive than old conjectures. Hyperon effects were found to be small at core bounce in an adiabatic collapse of a 15 $M_\odot$. In a gravitational collapse of a 40 $M_\odot$ star, abundant hyperons appear in a hot accreting proto-neutron star, and trigger the re-collapse to a black hole. Shorter neutrino bursts were proposed as a signal of softer EOS at high density and/or temperature.

QCD matter and phase diagram

QCD phase diagram with the Polyakov loop: Fukushima developed a chiral effective model with the Polyakov loop coupling proposed by himself to the three-flavor case and extensively explored the QCD phase diagram as a function of the temperature and the quark chemical potential. The Polyakov loop is a part of the gauge degrees freedom that acquires special significance at finite temperature, particularly around the critical temperature at which the chiral phase transition and the color deconfinement phase transition occur. In the model it was demonstrated that the model description admits a natural interpretation of the recently proposed state of QCD matter, i.e. the quarkyonic phase, as the chiral symmetric phase with vanishing Polyakov loop. Also, Fukushima looked systematically into the QCD critical point for various values of the $\mathrm{U_A}(1)$ breaking coupling and the vector-interaction strength using his model. He concluded that not only the location of the QCD critical point but also even its existence are affected by uncontrolled model parameters related to the $\mathrm{U_A}(1)$ breaking and the vector interaction, though the majority in the research field seems to believe in the existence of the QCD critical point. His conclusion poses a serious question to the QCD critical point search in planned experiments as well as in the lattice QCD simulation.

Chiral magnetic effect: Hot and dense QCD matter suppresses instantons but enhances QCD sphalerons which are topological excitations of gluon fields in Minkowskian space-time. Massless fermions can change the chirality through an interaction with QCD sphaleron excitations. Fluctuations with respect to the chirality lead to an interesting observable effect particularly under a strong magnetic field, which actually exists in a hot QCD medium created in heavy-ion collisions. Fukushima, in a collaboration with Dmitri Kharzeev at the Brookhaven National Laboratory (BNL) and Harmen Warringa at the Goethe University in Frankfurt, computed an electric current induced by such a difference between right-handed and left-handed fermions in number and the presence of an external magnetic field. The derivation clarified that such a chiral magnetic current has a clear anomaly origin and is insensitive to any infrared scales such as the fermion mass, the system temperature, etc. They discussed a physical implication to the experimental data from the STAR collaboration at BNL.

Low-lying Dirac eigenmodes and monopoles in compact QED: In QCD, the monopoles' degrees of freedom are considered to be responsible for color confinement and chiral symmetry breaking. Whereas there had been lots of studies on color confinement, few studies had been performed on the possible relationship between monopoles and chiral symmetry breaking. T.T. Takahashi analysed the compact QED system in (1+3)- and 4-dimensions, which has similar properties to QCD. He studied the properties of low-lying Dirac modes, which have a close relationship with low-lying Dirac eigenvalues responsible for the chiral symmetry breaking. He employed the overlap formalism for the fermion action, which realizes the exact chiral symmetry on a lattice. He paid attention to the spatial distributions of low-lying Dirac modes below and above the "phase transition temperature" T_c. As a result, near-zero modes were found to have universal spatial correlations with monopole currents, and were found to lose their temporal structures above T_c exhibiting stronger spatial localization properties, which implies that monopoles control the low-lying eigenvalue dynamics and are responsible for the chiral symmetry breaking/restoration as well as the charge confinement.

Entropy production in quantum mechanical processes: The early thermalization in heavy-ion collisions is one of the big remaining puzzles in RHIC physics. Ohnishi and collaborators proposed a broadly applicable formalism for the description of coarse grained entropy production in quantum mechanical processes. Based on the Husimi transform of the quantum state, which encodes the notion that information about any quantum state is limited by the experimental resolution, it was shown in the two analytically tractable cases (the decay of an unstable vacuum state and reheating after cosmic inflation) that the growth rate of the Wehrl entropy associated with the Husimi function approaches to that of the classical Kolmogorov-Sinaï entropy. They also discussed various possible applications of this formalism, including the production of entropy in the early stages of a relativistic heavy ion collision.

Phase diagram in the strong-coupling lattice QCD: It is a challenging problem to elucidate the phase diagram structure of hot and dense matter based on QCD. Miura, Ohnishi and collaborators investigated the chiral phase transition and its phase diagram based on the strong-coupling lattice QCD for color $SU(3)$ including the next-to-leading order (NLO) effects in the strong-coupling $(1/g^2)$ expansion. They derived an analytic expression of the effective potential, and investigated the phase diagram evolution with $\beta = 6/g^2$. The phase diagram evolves towards an empirical shape via modifications of the quark wave function renormalization factor, effective quark mass and effective chemical potential $(Z_\chi(\beta), \tilde{m}_q(\beta), \tilde{\mu}(\beta))$ with increasing β. They also developed a self-consistent treatment of quark number density and predicted a partially chiral-restored matter with medium density in the next to the hadron phase.

Canonical quantization of gauge fields in static space-times with applications to Rindler spaces: The canonical quantization of gauge fields in static space-times was worked out in the Weyl gauge by Yazaki in collaboration with Lenz and Ohta. With an appropriate definition of transverse and longitudinal components of gauge fields, the Gauss' law constraint was resolved explicitly for scalar and spinor QED and a complete non-perturbative solution was given for the quantized Maxwell-field coupled to external currents. The formalism was then applied in investigations of the electromagnetic field in Rindler spaces. The relation of creation and annihilation operators in Minkowski and Rindler spaces was established and initial value problems associated with bremsstrahlung of a uniformly accelerated charge were studied. The peculiar scaling properties of scalar and gauge theories in Rindler spaces were also discussed.

Particle Physics Group

Particle physics is a branch of physics studying the origin of matter and spacetime as well as their interactions, the most fundamental problems in Nature. Its final goal is to reveal the underlying physical laws and components of the nature. A lot of important mysteries are remaining unanswered, and this group has research activities in various directions to reach this goal.

In particle phenomenology, the current experimental results are accurately described by the Standard Model (SM) with $SU(3) \times SU(2) \times U(1)$ gauge group. However, this model cannot be a complete theory for the following reasons; it contains too many tunable parameters which can only be determined by experiments, it suffers from the hierarchy problem, and it does not contain the dark matter and the neutrino masses. Thus particle physics beyond the SM is actively investigated by many members of this group. The study of the Higgs sector is one of the main topics, since this sector explains the origin of the particle masses through the mechanism of the spontaneous symmetry breaking. Another important topic is the mechanism of the supersymmetry breaking. The existence of supersymmetry is highly expected, since this solves the hierarchy problem of the SM and unifies naturally the gauge couplings of the SM at a high energy scale, which suggests the existence of the Grand Unified Theory (GUT) of gauge fields and matters. On the other hand, however, supersymmetry is not observed in current experiments, and it is highly desired to find a natural way to reconcile this experimental fact with the theoretical requirement by finding an appropriate mechanism of spontaneous breaking of supersymmetry without destroying the desirable features. Supergravity, that is a local gauge theory of supersymmetry, is also investigated by some members of the group.

Quantum Chromodynamics (QCD) is a non-Abelian gauge theory coupled with matter fields. This theory describes the hadronic systems, and has various applications in particle phenomenology as well as in astrophysics. Because of its strong interactions, understanding of its properties requires non-perturbative approaches to quantum field theories. Lattice QCD gives a practical and powerful numerical method to analyze the non-perturbative aspects of QCD. Recently, a new method based on the duality between gravity and gauge theory has emerged from the study of string theory. This new method analyzes QCD in terms of gravity or string theory, and can relatively easily derive some results which are difficult to obtain directly from gauge theory.

It is yet not known how to incorporate the general relativity into the principle of quantum mechanics. Application of standard quantization procedure to the general relativity just leads to a problematic theory. It rather seems that a consistent theory of quantum gravity requires a new notion of spacetime, which replaces the classical spacetime notion that is a continuous smooth manifold. Noncommutative spacetime (or fuzzy space more generally) is a candidate, which actually has been found to appear in quantum gravity and string theory under certain conditions. Based on this quantum spacetime notion, quantum gravity is investigated by some of the group members.

String theory is a theory of one-dimensionally extended objects like string, trying to give a consistent unified theory of all the interactions and matters. To relate the string theory to the real nature, compactification is a necessary step, since the consistency of the string theory requires the spacetime dimension to be ten, and the extra six-dimensions must be compactified to small sizes. The way of compactification determines the contents of gauge theory and matters in low energy, and finding realistic compactifications is an important topic. This is studied by the group members, accompanied by the study of the mathematical structures of compactification. However, practically infinite possibilities exist as compactification, and non-perturbative formulation of the string theory seems to be required for it to have predictable powers to the real nature. As study in this direction, the string field theory and the M-theory are investigated by the group members, too. Black hole physics based on string theory and mathematical aspects of string theory are also actively studied by the group members.

Historically the development of particle physics came hand in hand with that of field theory, which is not only a common language of particle physics but also a central tool in modern theoretical physics, including cosmology, condensed matter, and statistical physics. Thinking of this powerful generality of field theory, some of the group members study some topics in condensed matter physics and integrable systems, which are seemingly unrelated to particle physics.

Particle phenomenology and supersymmetry

Kurachi and his collaborators have analyzed inelastic 2 to 2 scattering amplitudes for gauge bosons and Nambu-Goldstone bosons in deconstructed Higgsless models. Using the (KK) Equivalence Theorem in 4D (5D), they derived a set of general sum rules among the boson masses and multi-boson couplings that are valid for arbitrary deconstructed models. Taking the continuum limit, their results naturally include the 5D Higgsless model sum rules for arbitrary 5D geometry and boundary conditions.

Supersymmetric QCD has runaway-type superpotentials for small flavor numbers of massless quarks. In collaboration with F. Takahashi, T.T. Yanagida, K. Yonekura (Tokyo), *Izawa* pointed out that the runaway behavior can be stabilized by introducing singlets with the aid of perturbative corrections to the Kähler potential, generating (local) minima of dynamical supersymmetry breaking. This opens up a possibility of conformal supersymmetry breaking in further study.

If supersymmetry (SUSY) is realized in nature, it must be broken. *Nakai* and his collaborators studied gauge mediated supersymmetry breaking. The pivot of gauge mediation consists of messenger fields that are charged under the standard model gauge symmetries. In semi-direct gauge mediation models, the messengers are directly coupled to the hidden sector gauge fields but do not play a role in breaking SUSY. These models have a little hierarchy between the gaugino masses and the scalar masses without careful tuning. They ameliorated this hierarchy by proposing strongly coupled semi-direct gauge mediation models. Sizable mediation is realized to generate the standard model gaugino masses for a small mediator mass without breaking the standard model symmetries.

Sakai and his collaborators studied 10D super Yang-Mills theory with the gauge groups E_6, E_7 and E_8. They considered the torus/orbifold compactification with magnetic fluxes and Wilson lines. These lead to 4D interesting models with three families of quarks and leptons, whose profiles in extra dimensions are quasi-localized because of magnetic fluxes.

The N=8 supergravity theory has the particular property that all the one-soft-scalar emission amplitudes vanish in the soft momentum limit, which might be relevant to the finiteness of the N=8 supergravity theory. In collaboration with Renata Kallosh who stayed at YITP as the visiting professor, *Kugo* proved that property by using the low-energy theorem technique and the explicit form of the E_7 symmetry current based on the fact that those scalar particles are all Nambu-Goldstone bosons for the spontaneous breaking of E_7 to $SU(8)$.

QCD and lattice QCD

Ito and her collaborators investigated the running coupling constant for some gauge theories using lattice simulations. They proposed a new renormalization scheme of the running coupling constant in general gauge theories using the Wilson loops. The renormalized coupling constant is obtained from the Creutz ratio in lattice simulations and the corresponding perturbative coefficient at the leading order. The latter can be calculated by adopting the zeta-function resummation techniques. They performed a benchmark test of the scheme in quenched QCD with the plaquette gauge action. The running of the coupling constant is determined by applying the step-scaling procedure. Using several methods to improve the statistical accuracy, they showed that the running coupling constant can be determined in a wide range of energy scales with relatively small number of gauge configurations.

Murata and collaborators investigated the finite-temperature effects on the spectral function in the vector channel in the soft-wall AdS/QCD model.

Quantum gravity

Recently, it was shown that the effective field theory of the Ponzano-Regge model with which massive particles are coupled is given by a three dimensional noncommutative field theory in the Lie algebraic noncommutative spacetime. *Sasai* and *Sasakura* investigated the unitarity of the three dimensional noncommutative field theory. They also studied the relation between spinless massive particles coupled with 2+1 dimensional gravity and the noncommutative field theory.

As a model of quantum gravity, *Sasakura* studied the so called tensor model, which can be interpreted as a dynamical theory of fuzzy spaces. He constructed a certain class of tensor models which have emergent flat spaces as their classical solutions, and showed that the general relativity appears as an emergent phenomenon around these solutions.

String theory

— compactification —

Albertsson investigated the possibility to apply doubled geometry formalism to Poisson-Lie T-plurality, by studying and partly establishing the correspondence between the objects in the two frameworks. She moreover investigated and interpreted the mathematical structures supported on doubled geometry.

Albertsson and *Kimura* studied configurations of D-branes expanded in Hull's doubled geometries in collaboration with R.A. Reid-Edwards (DESY). They demonstrated a systematic method to derive and classify D-branes from the boundary conditions, in terms of embeddings both in the doubled geometry and in the physical target space. They applied it to the doubled three-torus with a constant H-flux and found D0-, D1-, and D2-branes, which they verified transform consistently under T-dualities, mapping the system to f-, Q- and R-flux backgrounds, respectively.

Kimura studied type II string theories compactified on (non)geometric backgrounds arisen from various fluxes in the framework of Hull's doubled geometries or Hitchin's generalized geometries. He considered flux vacua attractor equations in type IIA string theory compactified on generalized geometries. The four-dimensional N=1 superpotential in this compactification can be written as the sum of the Ramond-Ramond superpotential and a term described by (non)geometric flux charges. He exhibited a simple model in which supersymmetric AdS and Minkowski solutions are classified by means of discriminants of the two superpotentials.

Ohta and *Kunitomo* analyzed the $AdS_3 \times M_7$ type supersymmetric solutions of the Killing spinor equations in the heterotic supergravity. They classified these solutions by their G-structures and intrinsic torsions and also showed that if the Bianchi identities are imposed, the integrability conditions of the Killing spinor equations imply all the field equations including the leading order α'-corrections.

— formalism —

Khoriki, *Kugo*, *Kunitomo* and *Murata* studied in constructing a new formulation of open superstring field theory based on -1 and -1/2 picture for Neveu-Schwarz and Ramond string fields, respectively. They also confirmed reproducing the Koba-Nielsen amplitude and gave the supersymmetry transformation in this theory.

The pure spinor (PS) formalism allows quantization of superstrings in a manner that preserves the manifest super-Poincaré covariance. However, because of the lack of a reparametrization invariant action, the origins of various tools of the PS formalism are still unclear. The double spinor (DS) formalism, introduced by Aisaka and Kazama, is a candidate giving a Lagrangian description of the PS formalism. *Kunitomo* proposed a general method of constructing a reparametrization invariant action for backgrounds realized by coset superspaces. He found that it is natural to double not only the spinor coordinates but the whole superspace for describing double-spinor superstrings on such backgrounds. The reparametrization invariant action has local symmetries compensating those extra degrees of freedom, which guarantee the equivalence to the Green-Schwarz formalism.

— *M-theory* —
Terashima studied the effective action of multiple M2-branes in the M-theory. He found the explicit supersymmetry transformation of the action and the spike like solitons which represent M5-branes. *Terashima*, *Fuji* and *Yagi* with Masatoshi Yamazaki, found how to take the orbifolding of the M2-brane action.

— *black hole* —
Ogawa and *Terashima* investigated Mathur's fuzzball conjecture in Lin-Lunin-Maldacena bubbling geometries, and found some evidence which suggested the validity of the fuzzball conjecture there. They also researched on the Kerr/CFT correspondence, in collaborations with T. Azeyanagi (Kyoto U.), G. Compére (UCSB) and Y. Tachikawa (IAS). This series of works are explained in *Ogawa*'s article in the Research Highlights section.

— *conformal field theory* —
Eguchi continued his study on the representation theory of superconformal algebra (SCA). Together with K. Hikami (Naruto University of Education) he applied a theory of Mock theta functions to the analysis of expansion of elliptic genera of general hyper Kähler manifolds in terms of the characters of N=4 SCA. In particular he determined the asymptotic behavior of the growth of the coefficients of the non-BPS representations in the expansion of an elliptic genus.

Hosomichi worked (together with Jean-Emile Bourgine and Ivan Kostov at CEA Saclay) on the microscopic descriptions of boundary conditions in general two-dimensional conformal field theories, taking the example of the lattice $O(n)$ spin systems or the equivalent loop gas model. The goal of this project was to make use of the matrix model techniques (coupling the system to two-dimensional gravity) to understand better the new class of conformally invariant boundary conditions which break the $O(n)$ symmetry to subgroups, and the boundary renormalization group flows between them.

Condensed matter physics

A great deal of attention has recently been directed to graphene, an atomic layer of graphite, which supports "Dirac fermions" as charge carriers and which thus is of interest to particle physicists as well. Of particular interest is bilayer graphene which has a unique property that its band gap is externally tunable. *Misumi and Shizuya* pointed out that the fine splitting of nearly-degenerate pseudo-zero-mode Landau levels, specific to bilayer graphene in a magnetic field, is also controlled by an in-plane field; this leads to a possibility of the current-driven quantum Hall effect around filling factor $\nu = \pm 2$ in bilayer graphene. *Shizuya* examined further tunable properties of the pseudo-zero-mode levels and pointed out, in particular, that an interplay of the Coulomb interaction and an in-plane field leads to rich spectra of collective excitations, (orbital-)pseudospin waves. He also studied many-body corrections to cyclotron resonance in graphene and its bilayers, and made a comparison with some recent experiments.

Integrable systems

One of the best known solution methods for systems of finite or countably infinite degrees of freedom is the Bethe ansatz method. *Sasaki* with W-L. Yang and Y-Z. Zhang (Queensland) wrote down many examples of Bethe ansatz solutions for the quasi-exactly solvable difference systems introduced by him. He also presented many examples of exactly solvable birth and death processes, which are typical examples of the stationary Markov processes and could be considered as the discretisation of the random walk. The latter is described by the Fokker-Planck equations, which could be transformed into a Schrödinger equation. The discretised Schrödinger equation with various orthogonal polynomials, which were worked out in the previous year by him and Odake (Shinshu University), provide the exact solutions of various birth and death processes. Namely, the transition probabilities are explicitly given for 18 examples, which are closely related to orthogonal polynomials of a discrete variable, from the q-Meixner polynomilas to the q-Racah polynomials. He and Odake constructed a unified theory for exactly and quasi-exactly solvable discrete quantum mechanics in one-dimension. It has many new explicit examples. They also established the discrete version of Crum's theorem, the cornerstone of exactly solvable quantum mechanics, or the so-called factorisation method or susy quantum mechanics. Now these methods are available for the discrete quantum mechanics, too.

Yukawa International Program for Quark-Hadron Sciences

From the beginning of the academic year of 2007, Yukawa Institute for Theoretical Physics launched a new five-year project, "Yukawa International Program for Quark-Hadron Sciences (YIPQS)," sponsored by "Ministry of Education, Culture, Sports, Science and Technology – JAPAN (MEXT)."

Aim of the program

By the end of 1970's, the final understanding was reached that Quantum Chromodynamics (QCD) is the theory of the strong interaction which was originally discovered by Hideki Yukawa. Still, nevertheless, only little has been established from QCD on various possible forms of hadrons or quarks. For example, while scaling behaviors of the lepton-nucleon cross section in the deep-inelastic scattering region and some properties of ground state hadrons have been precisely understood in perturbative and lattice QCD calculations, respectively, the study of bare nuclear force just started very recently. It is a long way to go to understand the properties of excited hadrons above the threshold including the exotic hadrons, the binding mechanism of nuclei with more than two nucleons, the nuclear matter equation of state, the vacuum structures at extremely high temperature in the Early Universe and at extremely high density in compact stars, etc, from the fundamental theory, namely QCD. In other words, there is still a vast area of research interest which is to be explored. To advance the exploration, it is necessary not only to make full use of existing theoretical techniques but also to develop new theories and to establish new frameworks. The expected achievement would cast a strong impact on the understanding of various forms of matter at various levels in nature. One may face a situation that one should restructure the current understanding about possible forms of matter.

The primary purpose of the YIPQS is to establish a new area of research fields; the quark-hadron sciences. For this purpose, with cooperating with present and near-future experimental activities, Yukawa Institute for Theoretical Physics will advance theoretical research not only in quark-hadron physics but also in related areas, as listed below, which constitute indispensable building blocks for the quark-hadron sciences.

Examples of related areas include; quark-gluon plasma, hadron physics, lattice QCD, dark energy, dark matter, baryogenesis, CP violation, strongly-correlated systems, phase transition of internal degrees of freedom of matter, physics of the Early Universe, matter at extreme conditions, structure of unstable nuclei and nucleosynthesis, compact star physics, optical lattice, (super)string theory, AdS/CFT correspondence, non-perturbative and/or non-equilibrium dynamics, etc.

International collaboration program

As a core activity of the YIPQS, long-stay programs are organized on research topics ranging over quark-hadron physics and related fields of theoretical physics. The proposal of the program is open for the community, with a requirement that the organizing committee should include a member of Yukawa Institute. The theme of the long-stay program is selected by the YIPQS executive committee with taking account of comments and opinions from the international advisory committee. The program is to be endorsed by the steering/advisory committee of the Yukawa Institute. The proposed program plan is also to be examined by the user's committee of the Yukawa Institute.

Two to three long-stay programs will be held annually; the duration of each program is one to three months. World-leading scientists are invited for each theme, and the Yukawa Institute provides participants with relaxed and at-home atmosphere so that there may be active discussions and fruitful collaborations, which will hopefuly lead to Nobel-prize class results. To publicize the aim of creating and advancing the field of quark-hadron sciences, the activities and outcomes of the YIPQS will be announced regularly on the website, which is given at the end of this section.

In this academic year the following two long-stay programs were held;

1. Oct. 27 – Nov. 28, 2008: Spin Transport in Condensed Matter
   http://www.stcm_workshop.mp.es.osaka-u.ac.jp/
   Chairman: Hiroshi Kohno

2. Jan. 26 – Mar. 25, 2009: 16th YKIS: Particle Physics beyond the Standard Model
   http://www2.yukawa.kyoto-u.ac.jp/~ppbsm/
   Chairman: Taichiro Kugo

The detailed information of each program can be seen at the website written above.

Smaller-size international collaboration programs are also organized to cope with the rapid development of the research in this field. The program is named a "molecule-type" international program. It is expected that the group discussion in this small program will evolve to form a research collaboration. The proposal is received anytime within the budget limit. This program should involve at least one core participant from abroad, and should be long for two weeks or more. The selection of this program is also made by the executive committee.

In this academic year there were seven international programs of this molecule-type as listed below;

1. Apr. 1 – Jun. 30, 2008: Inflationary Cosmology
   Core members: Andrei Linde, Renata Kallosh, Misao Sasaki

2. Jul. 16 – Aug. 6, 2008: Aspects of Quantum Integrability

Core members: Edward Corrigan FRS, Junji Suzuki, Ryu Sasaki

3. Aug. 1 – Aug. 28, 2008: Entropy production before QGP
Core members: Andreas Schäfer, Berndt Müller, Akira Ohnishi

4. Oct. 1 – Oct. 31, 2008: Fundamental theory of nonequilibrium statistical mechanics from a view of complex eigenvalue problems of the Liouville operator, and its application to biological systems
Core members: Tomio Yamakoshi Petrosky, Valeri Barsegov, Buang Ann Tay, Naomichi Hatano, Hisao Hayakawa

5. Oct. 6 – Oct. 24, 2008: alpha-and dineutron-correlation in nuclear many-body systems
Core members: Peter Schuck, Yoshiko Kanada-En'yo

6. Oct. 16 – Nov. 5, 2008: Gravity with higher curvature and higher dimensional black holes
Core members: Christos Charmousis, Jiro Soda, Takahiro Tanaka

7. Mar. 5 – Mar. 19, 2009: Non-equilibrium quantum field theories and dynamic critical phenomena
Core members: Jürgen Berges, Mikhail Stephanov, Hirotsugu Fujii, Akira Ohnishi

Organization

The executive committee was organized in the Yukawa Institute to run the whole program. The committee members are;
Taichiro Kugo (chair), Tohru Eguchi, Ken-ichi Shizuya, Akira Ohnishi, Misao Sasaki, Takami Tohyama, Hisao Hayakawa, Takahiro Tanaka, Kenji Fukushima, Hiroshi Kunitomo, Teiji Kunihiro, Koichi Yazaki.

One special duty professor, one associate professor and three postdocs are hired to enhance the research activities at the Yukawa Institute.

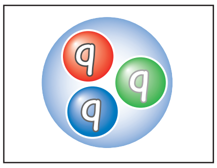
The website of the program is;
http://www2.yukawa.kyoto-u.ac.jp/~yipqs/index-e.html.

2.2 Research Highlights

N^* resonance as a $\bar{K}KN$ hadronic quasibound state

Daisuke Jido and Yoshiko Kanada-En'yo (YITP)

The study of hadron structure is one of the most important issues in hadron physics. The structure of baryon resonances has been investigated in quark models, in which symmetries of constituent quarks, such as spin, flavor and color, and their radial excitations play a major role to describe the wavefunctions of the baryon resonances. Since the baryon resonances decay into low-lying mesons and a baryon with the strong interactions, the resonances may have also large components of meson-baryon composite. For these components, inter-hadron dynamics is also important and gives essential contributions to understand the structure of the baryon resonances. These two pictures are



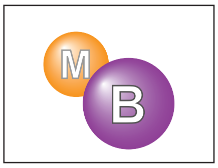


Figure 2.1: Schematic pictures of baryon resonances.

complementary, and which picture is realized in a baryon resonance depends on the energy scale to probe the resonance, since the interaction ranges are different in these pictures. Nevertheless, for some baryon resonances, the quark core components are not significant and the resonances are predominantly composed by hadrons. In such resonances, quarks are clustered and their dynamics are confined inside the constituent hadrons.

One of the long-standing candidates is the $\Lambda(1405)$ resonance considered as a $\bar{K}N$ quasibound state [1]. Using modern calculations based on chiral dynamics with unitary coupled-channels formulation reproducing the $\Lambda(1405)$ [2], it is suggested that the $\Lambda(1405)$ can be regarded as a dynamical state of meson and baryon [3]. It has been also suggested that the $f_0(980)$ and $a_0(980)$ scalar mesons are molecular states of $K\bar{K}$ [4].

In such multi-hadron systems, anti-kaon plays a unique role for hadron dynamics due to its heavier mass and Nambu-Goldstone boson nature. Current algebra indicates that the $\bar{K}N$ and $\bar{K}K$ interactions are strongly attractive in the s-wave channel. Owing to the heavy kaon mass, the s-wave interactions around the threshold are more effective than those for the pion. In addition, being aware that the typical kaon kinetic energy in the bound systems is small in comparison with the kaon mass, one may treat the kaons bound in multi-hadron systems with non-relativistic potential models done for nucleons in nuclear physics.

We consider hadronic molecule states of the $K\bar{K}N$ and $\bar{K}\bar{K}N$ systems with $I = 1/2$ and $J^P = 1/2^+$ in a non-relativistic three-body potential model [5], assuming that the $\Lambda(1405)$ resonance and the scalar mesons, $f_0(980)$, $a_0(980)$, are reproduced as quasibound states of $\bar{K}N$ and $K\bar{K}$, respectively. The effective two-body interactions are described by complex-valued functions representing the open channels, $(\pi\Lambda, \pi\Sigma)$ for $\bar{K}N$ and $(\pi\pi, \pi\eta)$ for $K\bar{K}$.

Performing non-relativistic three-body calculations with a variational method, we find a quasibound state of the $K\bar{K}N$ system around 1910 MeV below all of the meson-baryon decay threshold energies of the $\Lambda(1405)+K$, $f_0(980)+N$ and $a_0(980)+N$ states, which means that the obtained bound state is stable against breaking up to the subsystems. The state found here is a new baryon resonance of N^* with $J^P = 1/2^+$. This bound state is also confirmed later by a more sophisticated calculation using a relativistic Faddeev approach [6].

For the structure of the $K\bar{K}N$ system, we find that the subsystems of $\bar{K}N$ and $K\bar{K}$ are dominated by $I = 0$ and $I = 1$, respectively, and that these subsystems have very similar properties with those in the isolated two-particle systems. This leads to the picture that the $K\bar{K}N$ quasibound system can be interpreted as coexistence state of $\Lambda(1405)$ and $a_0(980)$ clusters, and $\bar{K}$ is a constituent of both $\Lambda(1405)$ and $a_0(980)$ at the same time. Consequently, the binding energy and width of the $K\bar{K}N$ state is almost the sum of those in $\Lambda(1405)$ and $a_0(980)$, and the dominant decay modes are $\pi\Sigma K$ from the $\Lambda(1405)$ decay and $\pi\eta N$ from the $a_0(980)$ decay, while the decays to $\pi\Lambda K$ and $\pi\pi N$ channels are suppressed. We also find that the root-mean-square radius of the $K\bar{K}N$ state is as larger as 1.7 fm and the inter-hadron distances are larger than 2 fm. These values are comparable to, or even larger than, the radius of ^{4}He and typical nucleon-nucleon distances in nuclei. Therefore, the $K\bar{K}N$ system more spatially extends than typical baryon resonances. These features are caused by weak binding of the three hadrons, for which the KN repulsive interaction plays an important role.

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Phase diagram evolution in strong coupling lattice QCD

Kohtaroh Miura (YITP)

Exploring a chiral phase transition in Quantum Chromodynamics (QCD) at finite temperature (T) and chemical potential (μ) and its phase diagram is one of the most important subjects in the quark-hadron physics. The chiral phase transition may really happen in compact astrophysical phenomena such as the early universe and compact stars, and can be investigated in heavy-ion collision experiments.

Lattice QCD Monte-Carlo (MC) simulations provide a rigorous and reliable framework, but, do not work well in the high density region because of the notorious sign problem of the Dirac determinant. In order to avoid this problem, Miura, Ohnishi and Kawamoto adopt a Strong Coupling Lattice QCD (SC-LQCD). The SC-LQCD is an "analytic" lattice QCD formulation based on the expansion by the inverse of the squared coupling $1/g^2$, and the sign problem can be avoided. The phase diagram in the strong coupling limit ($1/g^2 \to 0$) has been precisely investigated from both sides of analytic [1, 2] and numerical studies [3], and provides a good starting point to explore the true phase diagram by evaluating finite coupling effects in the strong coupling ($1/g^2$) expansions.

Based on these speculations, Miura and his collaborators have investigated the QCD phase diagram based on the SC-LQCD including the next-to-leading order (NLO) effects [4, 5]. They have used one species (four flavor) of staggered fermion. Main results are summarized as follows.

Phase Diagram Evolution The SC-LQCD is based on the lattice QCD, and a parameter is only $\beta = 6/g^2$. Miura *et al.* have investigated the *phase diagram evolutions* with β in NLO SC-LQCD [4], and obtained the result shown in Fig. 2.2. The phase diagram evolves towards an empirical shape where $\mu_{c,T=0} > T_{c,\mu=0}$ is satisfied, via the modifications of the quark wave function renormalization factor, effective quark mass and effective chemical potential $(Z_\chi(\beta), \tilde{m}_q(\beta), \tilde{\mu}(\beta))$ with increasing β. The behaviors $\mu_{c,T=0}(\beta)$ and $T_{c,\mu=0}(\beta)$ are understood from the quark mass reduction, and its cancellation with quark chemical potential reduction, respectively.

Comparison $\mathbf{T_{c,\mu=0}(\beta)}$ with MC results Since the SC-LQCD is based on the lattice QCD, the SC-LQCD results at $\mu = 0$, for instance, critical temperature $T_{c,\mu=0}(\beta)$, could be directly compared with those of MC simulations. The suppression of $T_{c,\mu=0}(\beta)$ obtained in NLO SC-LQCD is large, but not enough to explain the MC results. This problem indicates that the higher order effects of $1/g^2$ expansion would be necessary in order to obtain the true phase diagram.

Partially Chiral Restored Matter A quark number density ρ_q is naturally introduced as an order parameter through NLO effects, in addition to the chiral condensate σ. Miura *et al.* have found a Partially Chiral Restored (PCR) matter, [5] where $\tilde{\mu}(\beta) = \mu - \beta\rho_q/18$ is always adjusted to be around the quark excitation energy $E_q(\sigma)$. They have shown that the PCR matter is a common consequence of a self-consistent treatment for ρ_q. The PCR matter has a medium density and appears next to the hadron phase, hence, could be realized in neutron star cores. In Refs. [5], Miura and his collaborators have also discussed the relation between PCR matter and so-called quarkyonic matter [6].

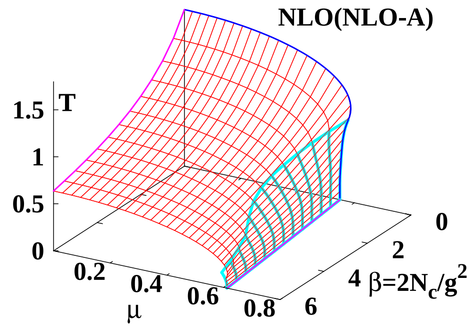

Figure 2.2: The phase diagram evolution including the NLO effects of the strong coupling expansion. The $T-\mu$ plane on the back-end corresponds to the strong coupling limit, and the finite coupling effect becomes larger in front. The thick-line surface represents the first-order transition region, and the other parts correspond to the second-order transition region.

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Aspects and generalizations of the Kerr/CFT correspondence

Noriaki Ogawa (YITP)

The Kerr/CFT correspondence

Quantum aspects of gravity is still largely in mystery. In the last decade we have experienced a remarkable progress for it, mainly in researches of black holes. In particular, based on the idea of gauge/gravity or open/closed string dualities, many black holes in string theory were examined and their statistical aspects have been developed.

Recently, a similar conjectural gauge/gravity duality was found in 4d extremal Kerr black holes, which do not have a simple D-brane construction in string theory. In this frame, named the Kerr/CFT correspondence [1], the dual theory is a 2d chiral conformal field theory (CFT).

By applying the Brown-Henneaux's framework [2] to the near-horizon extremal Kerr geometry, they successfully found an appropriate boundary condition with a chiral Virasoro algebra in the asymptotic symmetry group (ASG), and calculated the central charge of it. Finally they derived the statistical entropy S_{micro} via the Cardy formula, which precisely agrees with the Bekenstein-Hawking entropy S_{BH}.

Multiple dualities in $d \geq 5$

One immediate interest is the applicability of this method for other, wider systems, and its general aspects there. Apparently it seems to require extremality and rotation. As a first step to understand it deeper, we examined a 5d black hole with two independent rotating directions [3].

In this system, we found two different boundary conditions, corresponding to the two rotating directions. For each boundary condition, one Virasoro algebra, different from each other, is included in the ASG. Then correspondingly, we can consider two different boundary chiral CFT_2's for the one black hole. The two theories give the same value of S_{micro}, and it also agrees with S_{BH}. Interestingly, we could not find any consistent boundary condition that includes both of the two Virasoro algebras in the ASG, which would give a doubled entropy $S_{micro} = 2S_{BH}$.

Multiple Virasoro algebras for a higher-dimensional black hole was also independently found in [4], and the applicability of Kerr/CFT method for rather general 4d extremal black holes was shown in [5].

Kerr/CFT and string theory

A remarkable feature of the Kerr/CFT correspondence is that it does not depend on either supersymmetry or string theory at all, at least apparently. However, if we believe string theory in some sense, we are strongly motivated to investigate the standpoint and origin of the Kerr/CFT correspondence in string theory.

One of the most representative black holes in string theory is the D1-D5-P system. It is a 5d charged (rotating or non-rotating) black hole embedded in IIB superstring, and it exhibits AdS_3/CFT_2 correspondence, where the CFT_2 is non-chiral. We explored the relation between this non-chiral CFT_2 and the chiral CFT_2 in the Kerr/CFT in this system [6]. As the result, it is strongly suggested that the latter is the IR limit of the former, in the sense that the excitations of the right-movers are forbidden and only the left-movers are alive.

Up to now, it seems to be the only example where the detail of the boundary theory in Kerr/CFT was revealed.

Higher-derivative Kerr/CFT

All above are the cases of Einstein gravity, with or without matters. Then how about gravity theories with higher-derivative terms ? In such theories, thermodynamical black hole entropy is known to be given by the Iyer-Wald formula, which is a generalization of the Bekenstein-Hawking law. One important motivation for considering Kerr/CFT there is again in string theory, which includes Planck-suppressed higher-derivative terms in the low-energy effective action.

In higher-derivative gravity theories, to define the asymptotic charges and their commutation relations (Poisson brackets) is a more difficult problem than in Einstein gravity. Some different definitions gave the same result in Einstein gravity, but not in more general theories. We successfully found the most reasonable definition for them and established the Kerr/CFT procedure using it. It always gives correctly $S_{micro} = S_{IW}$ for extremal Kerr-type black holes in any 4d gravity theory [7].

It implies amazing universality and potential power of Kerr/CFT for further understanding of q uantum gravity.

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Development of low-temperature density matrix renormalization group method

Shigetoshi Sota and Takami Tohyama (YITP)

The density matrix renormalization group (DMRG) method [1] is a powerful numerical technique to investigate various properties of low-dimensional strongly correlated electron systems. By using the DMRG method, we can treat a large system that is difficult to be handled by a direct diagonalization method. In this paper, we introduce a new finite temperature DMRG method [2], which is suitable for the low-temperature region where quantum fluctuations of strongly correlated electron systems are important.

In the DMRG prodedure, we chose m bases states to describe the target states, with m being the truncation number of the density matrix. In the case of the DMRG procedure at zero temperature, the target state is the ground state. Even for finite temperatures, it may be possible to have a target state suitable for the evaluation of physical quantities. A possible target state may be given by

$$|\tilde{\xi}\rangle \equiv e^{-\beta\hat{H}/2}|\xi\rangle = \sum_{n=1}^{N} e^{-\beta\varepsilon_n/2} a_n |\varepsilon_n\rangle, \qquad (1)$$

where $\hat{H}$ is the Hamiltonian, $|\xi\rangle$ is a normalized arbitrary vector, β is the inverse temperature $1/T$, N is the dimension of the superblock, and $a_n = \langle\varepsilon_n|\xi\rangle$, with $|\varepsilon_n\rangle$ being the eigenvector corresponding to the eigenvalue ε_n. The inner product of Eq. (1) gives the partition function Z, provided that $a_n^2 = N^{-1}$: $Z = N\langle\tilde{\xi}|\tilde{\xi}\rangle = \sum_{n=1}^{N} e^{-\beta\varepsilon_n}$. Therefore, Eq. (1) is a good candidate for the target in the DMRG procedure. However, it is difficult to obtain all of the eigenstates $|\varepsilon_n\rangle$. We thus need to develop a new technique to treat the operator $e^{-\beta\hat{H}/2}$ precisely without obtaining $|\varepsilon_n\rangle$. By using the Legendre polynomial expansion for the delta function $\delta(x-x') = \sum_{l=0}^{\infty} w_l^{-1} P_l(x)P_l(x')$ with $w_l = 2/(2l+1)$, the Boltzmann factor reads

$$e^{-\beta\tilde{E}_n} = \int_{-1}^{1} d\varepsilon e^{-\beta'\varepsilon} \sum_{l=0}^{\infty} w_l^{-1} P_l(\varepsilon)P_l(\tilde{E}_n), \qquad (2)$$

where $\tilde{E}_n$ is an eigenvalue rescaled to be confined within the interval of $[-1,1]$. The corresponding rescaled Hamiltonian $\hat{H}_s$ is defined as $\hat{H}_s = w_H(\hat{H}-\lambda)$ with scaling parameters w_H and λ, and $\beta' \equiv w_H^{-1}\beta$.

In general, there appear so-called Gibbs oscillations in any polynomial expansion. The oscillations can be eliminated by introducing the Gaussian distribution function for the Legendre polynomial $P_l(\tilde{E}_n)$ [3]. The polynomial regulated by the Gaussian is defined as

$$\langle P_l(\tilde{E}_n)\rangle_\sigma \equiv \frac{1}{\sqrt{2\pi\sigma^2}} \int_{-1}^{1} dx e^{-\frac{(x-\tilde{E}_n)^2}{2\sigma^2}} P_l(x), \qquad (3)$$

where σ is the half width of the Gaussian distribution function set to be $2\pi/L$, where L denotes the highest number of l in the expansion and is determined so as to satisfy $e^{-\frac{(-1-\tilde{E}_n)^2}{2\sigma^2}} \ll 1$ and $e^{-\frac{(1-\tilde{E}_n)^2}{2\sigma^2}} \ll 1$. Inserting the Boltzmann factor Eq. (2) into the target state Eq. (1) and returning to the operator representation, we obtain

$$|\tilde{\xi}\rangle \simeq C(\beta') \sum_{l=0}^{L} w_l^{-1} i_l(-\beta'/2) \langle P_l(\hat{H}_s)\rangle_\sigma |\xi\rangle, \qquad (4)$$

where $C(\beta')$ is a normalization constant that is β' dependent. And $i_l(x)$ is the modified spherical Bessel function of the first kind, which is derived by the integration in Eq. (2) with respect to ε. In order to calculate $\langle P_l(\hat{H}_s)\rangle_\sigma$, we make use of a coalitional recursive relation for the Legendre polynomial [3]: $\langle P_{l+1}(x)\rangle_\sigma = \frac{2l+1}{l+1} x\langle P_l(x)\rangle_\sigma - \frac{l}{l+1}\langle P_{l-1}(x)\rangle_\sigma + \frac{2l+l}{l+1}\sigma^2\langle P_l'(x)\rangle_\sigma$ and $\langle P_{l+1}'(x)\rangle_\sigma = (2l+1)\langle P_l(x)\rangle_\sigma + \langle P_{l-1}'(x)\rangle_\sigma$, where $\langle P_l'(x)\rangle_\sigma$ is a derivative in terms of a variable x in Eq. (3). Starting from $\langle P_0(\hat{H}_s)\rangle_\sigma |\xi\rangle = |\xi\rangle$ and $\langle P_1(\hat{H}_s)\rangle_\sigma |\xi\rangle = \hat{H}_s|\xi\rangle$, we recursively calculate $\langle P_l(\hat{H}_s)\rangle_\sigma |\xi\rangle$ up to $l = L$ and construct the target state in Eq. (4).

In the DMRG procedure, physical quantities are measured when the system size is reached to a given number in the infinite-size algorithm or enough convergency is obtained in the finite-size algorithm [1]. At this stage, we need to introduce a technique to guarantee the relation $a_n^2 = N^{-1}$ for the coefficients in Eq. (1). This is achieved by taking the random sampling of the state $|\xi\rangle$ and averaging over the samplings. Let us represent a randomly generated $|\xi\rangle$ as $|\xi\rangle = \sum_i r_i|\xi_i\rangle$, where $|\xi_i\rangle$ is the basis state of the system and r_i is a normalized random number. Expanding the eigenstate $|\varepsilon_n\rangle$ also in terms of $|\xi_i\rangle$, i.e., $|\varepsilon_n\rangle = \sum_i b_{n,i}|\xi_i\rangle$, we obtain $a_n^2 = \sum_i r_i^2 b_{n,i}^2 + 2\sum_{i\neq j} r_i r_j b_{n,i} b_{n,j}$. After averaging over many samplings whose number is M_s, r_i^2 will become a constant approximately independent of i and $r_i r_j$ will vanish according to $1/\sqrt{M_s}$. Therefore, a relation $a_n^2 \simeq N^{-1}$ $(n = 1,\cdots,N)$ is expected to be satisfied. Physical quantities that do not commute with $\hat{H}$ are also obtained by using the random sampling and their averaging. Furthermore, we can also calculate dynamical quantities at finite temperature [2]. By using this method, we are now investigating the temperature dependence of the optical response of one-dimensional Mott insulators and the properties of a frustrated spin-1/2 zigzag chains.

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08-107 Kohta Murase, *Prompt high-energy neutrinos from gamma-ray bursts in photospheric and synchrotron sel-Compton scenarios* (2009 March); Phys. Rev. **D78** (2008) 101302. arXiv:0807.0919[astro-ph].

08-108 C. Ishizuka, A. Ohnishi, K. Tsubakihara, K. Sumiyoshi, S. Yamada, *Tables of Hyperonic Matter Equation of State for Core-Collapse Supernovae* (2009 November); J. Phys. **G35** (2008) 085201. arXiv:0802.2318[nucl-th].

08-109 R. Mizukawa, T. Hirano, M. Isse, Y. Nara, A. Ohnishi, *Search for a Ridge Structure Origin with Shower Broadening and Jet Quenching* (2009 November); J. Phys. **G35** (2008) 104083. arXiv:0805.2795[nucl-th].

08-110 K. Miura, N. Kawamoto, A. Ohnishi, *Hadron mass spectrum in strong coupling limit of lattice QCD at finite temperature and density for color SU(3)* (2009 November); Prog. Theor. Phys. Suppl. **174** (2008) 250. .

08-111 Akira Ohnishi, Kohtaroh Miura, *Quarkyonic phase in the strong coupling region of lattice QCD* (2009 November); PoS LATTICE 2008 (2008)192. .

08-112 Kohtaroh Miura, Akira Ohnishi, Noboru Kawamoto, *Strong coupling lattice study of 1/g2 evolution in phase diagram and baryon mass* (2009 November); PoS LATTICE 2008 (2008) 075. .

08-113 K. Izumi and T. Tanaka, *Particle production in models with helicity-0 graviton ghost in de Sitter spacetime* (November 2009); Prog. Theor. Phys. **121** (2009) 427. arXiv:0810.4811[hep-th].

2.3.2 Publications and Talks by Regular Staff (April 2008 — March 2009)

Tohru Eguchi

Journal Papers

1. T. Eguchi and K. Hikami, "Superconformal Algebra and Mock Theta Functions," J.Phys.A42:304010,2009, YITP-08-101, arXiv:0812.1151 [math-ph].

Talks at International Conferences

1. "Decoupling Limit in String Theory and the Mass Hierarchies " Invited, Plenary, at 50-th anniversary of IHES, Paris, 17–20 June 2008.
2. "N=2 Liouville Theory "in "Liouville Gravity and Lattice Statistics, "Invited, Plenary, Poncelet Inst. Moscow, 21–24 June 2008.
3. "Superconformal Algebra and Mock Theta Functions, " Invited, Plenary, in "Algebraic Geometry and Physics", Hangzhou, China, 20–24 September 2008.
4. "Superconformal Algebra and Mock Theta Functions, " Invited, Plenary, in "Applied sigma model", DESY, Hamburg, 10–14 November 2008.

Invited Seminars (in Japan)

1. "Einstein and Mystery of Universe," (in Japanese) Kyoto University GCOE Program "The Next Generation of Physics, Spun from Universality & Emergence", Public Lecture Series, Kyoto University, 30 November 2008.
2. "Heterotic Type II Duality," (in Japanese), KEK Workshop, 2 December 2008.
3. "Professor Nambu and the developments of string theory," (in Japanese), Japan Physical Society General Meeting, Symposium in commemoration of Dr. Yoichiro Nambu's Nobel Prize, Rikkyo University, 27 March 2009.

Kenji Fukushima

Journal Papers

1. K. Fukushima, "Characteristics of the eigenvalue distribution of the Dirac operator in dense two-color QCD," JHEP **0807** (2008) 083 (19 pages), YITP-08-45, arXiv:0806.1104 [hep-ph].
2. K. Fukushima and Y. Hidaka, "Two gluon production and longitudinal correlations in the Color Glass Condensate," Nucl. Phys. **A813** (2008) 171 (26 pages), YITP-08-47, arXiv:0806.2143 [hep-ph].
3. Z. Zhang, K. Fukushima and T. Kunihiro, "Number of the QCD critical points with neutral color superconductivity," Phys. Rev. **D79** (2009) 014004 (14 pages), YITP-08-69, arXiv:0808.3371 [hep-ph].
4. K. Fukushima, "Critical surface in hot and dense QCD with the vector interaction," Phys. Rev. **D78** (2008) 114019 (6 pages), YITP-08-76, arXiv:0809.3080 [hep-ph].
5. H. Fujii, K. Fukushima and Y. Hidaka, "Initial energy density and gluon distribution from the Glasma in heavy-ion collisions," Phys. Rev. **C79** (2009) 024909 (14 pages), YITP-08-51, arXiv:0811.0437 [hep-ph].
6. K. Fukushima, "Isentropic thermodynamics in the PNJL model," Phys. Rev. **D79** (2009) 074015 (9 pages), YITP-08-84, arXiv:0901.0783 [hep-ph].
7. H. Abuki and K. Fukushima, "Gauge dynamics in the PNJL model: Color neutrality and Casimir scaling," Phys. Lett. **B676** (2009) 57 (5 pages), YITP-08-98, arXiv:0901.4821 [hep-ph].
8. M. Fujita, K. Fukushima, T. Misumi and M. Murata, "Finite-temperature spectral function of the vector mesons in an AdS/QCD model," Phys. Rev. **D80** (2009) 035001 (5 pages), YITP-09-19, arXiv:0903.2316 [hep-ph].

Talks at International Conferences

1. "QCD Critical Point," Invited, in "The 2nd Asian Triangle Heavy Ion Conference," Center for Computational Sciences, Univ. of Tsukuba, Tsukuba, Japan, 13–15 Oct. 2008.

2. “Strangeness in the PNJL model,” Invited, Plenary, in “International Conference on Strangeness in Quark Matter 2008,” Tsinghua Univ., Beijing, China, 6–10 Oct. 2008.
3. “Phase Diagram in the PNJL Model,” Invited, in “Fundamental Challenges of QCD,” Schladming, Styria, Austria, 28 Feb.–7 March 2009.

Invited Seminars (Overseas)

1. “PNJL Model,” Institut für Theoretische Physik, J.W. Goethe-Universität, Germany, Nov. 2008.

Invited Seminars (in Japan)

1. “Introduction to the McLerran-Venugopalan (MV) model and application to heavy-ion collisions,” Dept. Physics, Univ. of Tokyo, December 2008.
2. “Various Faces of Extreme QCD,” Dept. Physics, Kyusyu Univ., December 2008.
3. “Glasma – from the Color Glass Condensate to a Quark-Gluon Plasma,” KEK, January 2009.
4. “Gluon Saturation,” Dept. Physics, Nagoya Univ., Feb. 2009.

Hisao Hayakawa

Journal Papers

1. Taka H. Nishino and Hisao Hayakawa, “Fluctuation-dissipation-relation-preserving field theory of the glass transition in terms of fluctuating hydrodynamics,” Phys. Rev. E **78** (2008) 061502 (11 pages).
2. Hiroto Kuninaka and Hisao Hayakawa, “Super-elastic collisions in a thermally activated system,” Prog. Theor. Phys. Suppl. **178** (2009) 157-163.
3. Hisao Hayakawa and Michio Otsuki, “Are there long-time tails in granular flows?” Prog. Theor. Phys. Suppl. **178** (2009) 49-55.
4. Michio Otsuki and Hisao Hayakawa, “Time correlation function of the shear stress in sheared particle systems,” Prog. Theor. Phys. Suppl. **178** (2009) 56-63.
5. Michio Otsuki and Hisao Hayakawa, “Universal Scaling for the Jamming Transition,” Prog. Theor. Phys. **121** (2009) 647-655.
6. Michio Otsuki and Hisao Hayakawa, “Spatial correlations in sheared isothermal liquids: From elastic particles to granular particles,” Phys. Rev. E, **79** (2009) 021502 (16 pages).
7. Hiroto Kuninaka and Hisao Hayakawa, “Simulation of cohesive head-on collisions of thermally activated nanoclusters,” Phys. Rev. E, **79** (2009) 031309 (9 pages).

Books and Proceedings

1. Hisao Hayakawa and Hiroto Kuninaka, “Super-elastic collisions of thermal activated nanoclusters,” in the proceeding of the Summer School of Advanced Problems in Mechanics 2008, 306–317 (2008), arXiv:0805.0176 [cond-mat].
2. Michio Otsuki and Hisao Hayakawa, “Long-range correlation in sheared granular fluids,” in Rarefied Gas Dynamics: Proceedings of the 26th International Symposium on Rarefied Gas Dynamics, edited by T. Abe, AIP Conf. Proc. **1084** (2009) 57-62, arXiv:0809.1118 [cond-mat].

Talks at International Conferences

1. “Super-elastic collisions of thermally activated nanoclusters,” Invited, Plenary, in “International Summer School-Conference: Advanced Problems in Mechanics 2008, ” St. Peterburg, Russia 6–10 July 2008.
2. “Spatial correlations in sheared moderate dense granular gases,” Invited, in “Granular Gases 2008,” Schloss Thurnau, Germany, 8–12 September 2008.
3. “Liouville equation for granular gases,” Invited, in “Fundamental theory of nonequilibrium statistical mechanics from a view of complex eigenvalue problems of Liouville operator, and its application to biological systems,” YITP, Kyoto, 1–31, October 2008.
4. “FDR preserving field theory of fluctuating hydrodynamics in describing glass transition,” Invited, in “Frontiers of Glassy Physics,” YITP, Kyoto, 19–22, November 2008.
5. “Can we use mode-coupling theory for sheared granular fluids?,” in “Unifying

Concepts in Glass Physics IV," Shirankaikan, Kyoto, 25–28, November 2008.

Invited Seminars (in Japan)

1. "Fluid Mechanics of Granular Flows - Constitutive equations and long range-long time correlations -," Dept. Mathematics, Keio Univ., 9 May 2008.
2. "A field theoretical approach to glass transition: can fluid model remove erodic transition?" Dept. Phys. and Appl. Phys., Univ. Tokyo, 13 June 2008.
3. "Nonequilibrium response of sheared granular materials," Gakushi Kaikan, Tokyo, 2 March 2009.

Ken-Iti Izawa

Journal Papers

1. M. Ibe, K.-I. Izawa, Y. Nakai, "Strongly Coupled Semi-Direct Mediation of Supersymmetry Breaking," Phys. Rev. **D80** (2009) 035002 (4 pages), YITP-08-97, arXiv:0812.4089[hep-ph].
2. K.-I. Izawa, F. Takahashi, T.T. Yanagida, K. Yonekura, "Runaway Dynamics and Supersymmetry Breaking," Phys. Lett. **B677** (2009) 195-196, arXiv:0902.3854[hep-th].
3. K.-I. Izawa, "Dynamical SUSY Breaking in SQCD: 25 Years Later," Proceedings of YKIS2008, Prog. Theor. Phys. Suppl. **180** (2009) 154-159.

Talks at International Conferences

1. "Dynamical SUSY Breaking in SQCD: 25 Years Later," in 16th YKIS "Particle Physics beyond the Standard Model," 26 January – 25 March 2009, YITP.

Daisuke Jido

Journal Papers

1. Daisuke Jido, Yoshiko Kanada-En'yo, "$K\bar{K}N$ molecule state with $I = 1/2$ and $J^P = 1/2^+$ studied with three-body calculation," Phys. Rev. **C78** (2008) 035203 (10 pages), arXiv:0806.3601 [nucl-th], YITP-08-53.
2. D. Jido, T. Hatsuda, T. Kunihiro, "In-medium pion and partial restoration of chiral symmetry," Phys. Lett. **B670** (2008) 109-113, arXiv:0805.4453 [nucl-th], YITP-07-23.
3. Yoshiko Kanada-En'yo, Daisuke Jido, "$\bar{K}\bar{K}N$ molecule state in three-body calculation," Phys. Rev. **C78** (2008) 025212 (10 pages), arXiv:0804.3124 [nucl-th], YITP-08-29.
4. L. Roca, T. Hyodo, D. Jido, "On the nature of the $\Lambda(1405)$ and $\Lambda(1670)$ from their N_c behavior in chiral dynamics," Nucl. Phys. **A809** (2008) 65-87, arXiv:0804.1210 [hep-ph], YITP-08-24.
5. T. Sekihara, T. Hyodo, D. Jido, "Electromagnetic mean squared radii of $\Lambda(1405)$ in chiral dynamics," Phys. Lett. **B669** (2008) 133-138, arXiv:0803.4068 [nucl-th], YITP-08-21.
6. Tetsuo Hyodo, Daisuke Jido, Atsushi Hosaka, "Origin of the resonances in the chiral unitary approach," Phys. Rev. **C78** (2008) 025203 (13 pages), arXiv:0803.2550 [nucl-th], YITP-08-20.
7. Toru Kojo, Daisuke Jido, "Sigma meson in pole-dominated QCD sum rules," Phys. Rev. **D78** (2008) 114005 (19 pages), arXiv:0802.2372 [hep-ph], YITP-08-8.
8. D. Jido, E.E. Kolomeitsev, H. Nagahiro, S. Hirenzaki, "Level crossing of particle-hole and mesonic modes in eta-mesonic nuclei," Nucl. Phys. **A811** (2008) 158-178, arXiv 0801.4834 [nucl-th], YITP-08-4.
9. D. Jido, M. Doering, E. Oset, "Transition form factors of the $N^*(1535)$ as a dynamically generated resonance," Phys. Rev. **C77** (2008) 065207 (17 pages), arXiv:0712.0038 [nucl-th], YITP-07-83.

Books and Proceedings

1. Toru Kojo, Daisuke Jido, "QCD Sum Rules and $1/N_c$ expansion," Prog. Theor. Phys. Suppl. **174** (2008) 258-261. Proceedings for Workshop on New Frontiers in QCD 2008, - fundamental problems in hot and/or dense matter - (NFQCD08), Kyoto, Japan, Jan 28 - Mar 21, 2008.
2. Takayasu Sekihara, Tetsuo Hyodo, Daisuke Jido, "Electromagnetic Mean Squared Radii of $\Lambda(1405)$ in Meson-baryon Dynamics with Chiral Symmetry," Prog. Theor. Phys.

Suppl. **174** (2008) 266-269. Proceedings for Workshop on New Frontiers in QCD 2008, - fundamental problems in hot and/or dense matter - (NFQCD08), Kyoto, Japan, Jan 28 - Mar 21, 2008.

3. T. Sekihara, T. Hyodo, D. Jido, "Electric Mean Squared Radii of $\Lambda(1405)$ in Chiral Dynamics," Mod. Phys. Lett. **A23** (2008) 2421-2424. Proceedings for Workshop on Chiral Symmetry in Hadron and Nuclear Physics (Chiral07), Osaka, Japan, Nov 13-16, 2007.
4. Daisuke Jido, Tetsuo Hyodo, Atsushi Hosaka, "The Structure of $N(1535)$ in the aspect of chiral symmetry," Mod. Phys. Lett. **A23** (2008) 2389-2392. Proceedings for Workshop on Chiral Symmetry in Hadron and Nuclear Physics (Chiral07), Osaka, Japan, Nov 13-16, 2007.
5. Junko Yamagata, Satoru Hirenzaki, Hideko Nagahiro, Daisuke Jido, "Structure and formation of kaonic atoms and kaonic nuclei," Mod. Phys. Lett. **A23** (2008) 2528-2531. Proceedings for Workshop on Chiral Symmetry in Hadron and Nuclear Physics (Chiral07), Osaka, Japan, Nov 13-16, 2007
6. Toru Kojo, Daisuke Jido, "Scalar Nonets in Pole-Dominated QCD Sum Rules," Mod. Phys. Lett. **A23** (2008) 2230-2233. Proceedings for Workshop on Chiral Symmetry in Hadron and Nuclear Physics (Chiral07), Osaka, Japan, Nov 13-16, 2007.
7. Hideko Nagahiro, Daisuke Jido, Satoru Hirenzaki,
"Study of in-medium of $N^*(1535)$ and chiral symmetry for baryons through the η-mesic nuclei formation at J-PARC," Mod. Phys. Lett. **A23** (2008) 2512-2515. Proceedings for Workshop on Chiral Symmetry in Hadron and Nuclear Physics (Chiral07), Osaka, Japan, Nov 13-16, 2007
8. Tetsuo Hyodo, Wolfram Weise, Daisuke Jido, Luis Roca, Atsushi Hosaka,
"Exotic hadrons and SU(3) chiral dynamics," Mod. Phys. Lett. **A23** (2008) 2393-2396. Proceedings for Workshop on Chiral Symmetry in Hadron and Nuclear Physics (Chiral07), Osaka, Japan, Nov 13-16, 2007.
9. E. Oset, M. Doring, D. Strottman, D. Jido, M. Napsuciale, K. Sasaki, C.A. Vaquera-Araujo, M. Kaskulov, E. Hernandez, H. Nagahiro, S. Hirenzaki,
"Photo- and Electron-Production of Mesons on Nucleons and Nuclei," Prog. Part. Nucl. Phys. **61** (2008) 260-275, Lectures given at International School of Nuclear Physics: 29th Course: Quarks in Hadrons and Nuclei, Erice, Sicily, Italy, 16-24 Sep 2007.

Talks at International Conferences

1. "Structure of the N(1535) in chiral dynamics," invited, Plenary, in Workshop on Hadron Dynamics, 25-28 Sept, 2008, Almunyecar, Spain.
2. "Baryon resonances as hadronic molecule states with kaons," in International Conference on Exotic Atoms (EXA2008), 15-18 Sept, 2008, Vienna, Austria.

Invited Seminars (Overseas)

1. "Baryon resonances as hadronic molecule states," Physics Department, Technische Universität München, Germany, 23 September 2008.

Invited Seminars (in Japan)

1. "Exotic structure of $\Lambda(1405)$ and K meson nuclear physics, (In Japanese)"
Physics Department, Nara Women's University, 10 November 2008.

Yoshiko Kanada-En'yo

Journal Papers

1. Y. Kanada-En'yo and D. Jido, "$\bar{K}\bar{K}N$ molecular state in a three-body calculation," Phys. Rev. **C78**, 025212-1-10 (2008).
2. D. Jido and Y. Kanada-En'yo, "$K\bar{K}N$ molecular state with $I = 1/2$ and $J^P = 1/2^+$ studied with a three-body calculation," Phys. Rev. **C78**, 035203-1-10 (2008).
3. Y. Kanada-En'yo, Y. Kawanami, Y. Taniguchi and M. Kimura, "Cluster states in ^{13}B," Prog. Theor. Phys. **120**, 917-935 (2008).
4. Y. Taniguchi, Y. Kanada-En'yo and M. Kimura, "Deformations and clustering correlations in p- and sd-shell nuclei using the Gogny and Skyrme interactions," Prog. Theor. Phys. **121**, 533-553 (2009).

Books and Proceedings

1. Y. Kanada-En'yo, Y. Taniguchi and M. Kimura, "Excited states of ^{13}B and ^{8}He and their cluster aspect," Proc. of the International Symposium on Physics of Unstable Nuclei(ISPUN07), Hoi An, Vietnam, July 3-7, ed. by Dao Tien Khoa, Peter Egelhof, Sydney Gales, Nguyen Van Giai and Tohru Motobayashi, pp67-74 World scientific, 2008.
2. Y. Kanada-En'yo, M. Kimura, Y. Taniguchi and T. Suhara, "Cluster structure of unstable nuclei studied with AMD," The first Workshop on State of the Art in Nuclear Cluster Physics, Strasbourg, May 13 -May 16, 2008, Int. Jour. Mod. Phys. E **17**, 2336-2344, 2008.
3. Tadahiro Suhara, Yoshiko Kanada-En'yo, "Structure of excited states in C-14," Int. J. Mod. Phys. **A24**, 2183-2190, 2009.
4. Yasutaka Taniguchi, Yoshiko Kanada-En'Yo, Masaaki Kimura, "Cluster structures in Si-28," Int. J. Mod. Phys. **A24**, 2069-2075, 2009.

Talks at International Conferences

1. "Cluster structure of unstable nuclei studied with AMD," The first Workshop on State of the Art in Nuclear Cluster Physics (SOTANCP08), May 13 -May 16, 2008, Strasbourg, France (invited).
2. "Shape coexistence in N=14 nuclei," Workshop on "Frontier in Unstable Nuclear Physics," 18-19 July 2008, Hokkaido University, Sapporo.
3. "Structure of light unstable nuclei studied with effective interactions," First EMMI-EFES workshop on neutron-rich exotic nuclei EENEN 09, Feb. 10, 2008, Darmstadt, Germany (invited).
4. "Cluster aspect of nuclear systems," "International Symposium on Nanoscience and Quantum Physics, nanoPHYS'09", Feb.23-25, Tokyo, Japan (invited).

Invited Seminars (in Japan)

1. Lecture series "Cluster structures in Nuclei" (in Japanese), 17-19 June 2008, Tokyo Institute of Technology, Tokyo.
2. Lecture "A Guide to Particle and Nuclear Physics" (in Japanese), Saturday Afternoon Physics 2008, 8 November 2008, Osaka University, Osaka.

Taichi Kugo

Journal Papers

1. Renata Kallosh and Taichiro Kugo, "The Footprint of E_7 in Amplitudes of $N = 8$ Supergravity," JHEP **0901** (2009) 072(1-16). arXiv:0811.3414 [hep-th]. YITP-08-87.

Talks at International Conferences

1. "Closing Remarks by a Rehabilitant," in YKIS workshop "Particle Physics beyond the Standard Model," Yukawa Institute, Kyoto, Jan. 26 – March 25, 2009.

Invited Seminars (in Japan)

1. "Electric Dipole Moment of Dyon and Electron" (in Japanese), Dept. Physics, Niigata Univ., 15 January 2009.

Hiroshi Kunitomo

Journal Papers

1. Hiroshi Kunitomo, "Double-Spinor Superstrings on Coset Superspaces," Prog. Theor. Phys. **120** (2008) 1029-1040, arXiv:0809.4895, YITP-08-79.

Invited Seminars (in Japan)

1. Double-Spinor Superstrings on Coset Superspaces (in Japanese). Japan Physical Society Meeting, Yamagata University, Yamagata, 21 September 2008.

Takao Morinari

Journal Papers

1. T. Morinari, "Fluctuation effect in the π-flux state for undoped high-temperature superconductors," J. Phys. Soc. Jpn. **77**, 114708 (2008).
2. T. Morinari, T. Himura, and T. Tohyama, "Possible verification of tilted anisotropic Dirac cone in α-(BEDT-TTF)$_2$I$_3$ using interlayer magnetoresistance," J. Phys. Soc. Jpn. **78**, 023704 (2009).

Books and Proceedings

1. T. Morinari, "Fermi arc formation by chiral spin textures in high-temperature superconductors," J. Phys. Chem. Solids **69**, 2960-2962 (2008).

Talks at International Conferences

1. "Quantum oscillations and Fermi surface topology in underdoped high temperature superconductors," Invited talk at the International Workshop on "Inelastic Neutron and X-Ray Scattering in Strongly Correlated Electron Systems," Institute for Materials Research, Tohoku University, 1–3 October 2008.

Invited Seminars (in Japan)

1. "Theory for inter-layer magnetoresistance in α-(BEDT-TTF)$_2$I$_3$ (in Japanese)," RIKEN, 18 December 2008.

Masatoshi Murase

Journal Papers

1. M. Murase, "Endo-exo circulation as a paradigm of life: towards a new synthesis of Eastern philosophy and Western science," In: What is Life? The Next 100 Years of Yukawa 's Dream (eds. Masatoshi Murase and Ichiro Tsuda), Prog. Theor. Phys. Suppl. **173** (2008) 1-10.
2. M. Murase, ed. Proceedings: What is Life? The Next 100 Years of Yukawa's Dream, Progr. Theor. Phys. Suppl. **173** (2008) 370pp.

Talks at International Conferences

1. "Endo-exo circulation as an elementary process of life, " (Plenary), The 5th International Conference on Nonlinear Science, Nara-Japan, Sep.9–12, 2008

Shigehiro Nagataki

Journal Papers

1. Kentaro Tanabe and Shigehiro Nagataki, "Extended monopole solution of the Blandford-Znajek mechanism: Higher order terms for a Kerr parameter," Phys. Rev. **D78** (2008) 024004.
2. Kohta Murase, Kunihito Ioka, Shigehiro Nagataki, Takashi Nakamura, "High-energy cosmic-ray nuclei from high- and low-luminosity gamma-ray bursts and implications for multimessenger astronomy," Phys. Rev. **D78** (2008) 023005.
3. Kohta Murase, Keitaro Takahashi, Susumu Inoue, Kiyotomo Ichiki, Shigehiro Nagataki, "Probing Intergalactic Magnetic Fields in the GLAST Era through Pair Echo Emission from TeV Blazars," Astrophys. J. **686** (2008) L67-L70.
4. Keitaro Takahashi, Kohta Murase, Kiyotomo Ichiki, Susumu Inoue, Shigehiro Nagataki, "Detectability of Pair Echoes from Gamma-Ray Bursts and Intergalactic Magnetic Fields," Astrophys. J. **687** (2008) L5-L8.
5. Kohta Murase, Susumu Inoue, Shigehiro Nagataki, "Cosmic Rays above the Second Knee from Clusters of Galaxies and Associated High-Energy Neutrino Emission," Astrophys. J. **689** (2008) L105-L108.
6. Yosuke Mizuno, Bing Zhang, Bruno Giacomazzo, Ken-Ichi Nishikawa, Philip E. Hardee, Shigehiro Nagataki, Dieter H. Hartmann, "Magnetohydrodynamic Effects in Propagating Relativistic Jets: Reverse Shock and Magnetic Acceleration," Astrophys. J.**690** (2009) L47-L51.

Books and Proceedings

1. Shigehiro Nagataki, "Numerical Simulations of the Central Engine for Long Gamma-Ray Bursts," 37th COSPAR Scientific Assembly. Held 13-20 July 2008, in Montreal, Canada., p.2158.
2. Akira Mizuta, Tatsuya Yamasaki, Shigehiro Nagataki, Shin Mineshige, "Relativistic Jet Propagation in the Progenitor of GRBs," Relativistic Astrophysics Legacy and Cosmology - Einstein's, ESO Astrophysics Symposia, Volume . ISBN 978-3-540-74712-3. Springer-Verlag Berlin Heidelberg, 2008, p. 391.
3. Kohta Murase, Kunihito Ioka, Shigehiro Nagataki, "Pair-Signatures and High-Energy Gamma-Ray Emission from Gamma-Ray Bursts," GAMMA-RAY BURSTS 2007: Proceedings of the Santa Fe Conference. AIP Conf. Proc. **1000** (2008) 373-376.
4. Kunihito Ioka, Kohta Murase, Kenji Toma, Shigehiro Nagataki, Takashi Nakamura, "Unstable GRB Photospheres and Blueshifted e+/- Annihilation Lines," GAMMA-RAY BURSTS 2007: Proceed-

ings of the Santa Fe Conference. AIP Conf. Proc. **1000** (2008) 377-380.
5. Shigehiro Nagataki, "Effects of Neutrinos and General Relativity for the Central Engine of Long GRBs," GAMMA-RAY BURSTS 2007: Proceedings of the Santa Fe Conference. AIP Conf. Proc. **1000** (2008) 409-412.
6. Kunihito Ioka, Kohta Murase, Kenji Toma, Shigehiro Nagataki, Takashi Nakamura, Peter Meszaros, "Unstable e+/- Photospheres and GRB Spectral Relations," 2008 NANJING GAMMA-RAY BURST CONFERENCE. AIP Conf. Proc. **1065** (2008) 189-194.

Talks at International Conferences

1. "High Energy Neutrino Astronomy," in "International School of Cosmic Ray Astrophysics, " Invited, Sicily, Italy, 5–12 July 2008.
2. "Numerical Simulations of the Central Engine for Long Gamma-Ray Bursts," in "37th COSPAR Scientific Assembly, "Montreal, Canada, 13–20 July 2008.
3. "Understanding of GRB-SN Connection by General Relativistic MHD Simulations," in "Frontiers of Space Astrophysics: Neutrino Stars and Gamma-Ray Bursts, "Cairo, Egypt, 30 March – 4 April 2009.

Invited Seminars (Overseas)

1. "Numerical Simulations of the Central Engine of Long Gamma-Ray Bursts," Nanjing University, China, 23 September 2008.
2. "Central Engine of Long GRBs and High-Energy Neutrinos from GRBs," APC, Paris, France 23 February 2009.
3. "Understanding of GRB-Supernova Connection by General Relativistic MHD Simulations," LUTH, Paris, France 25 February 2009.
4. "Understanding of GRB-Supernova Connection by General Relativistic MHD Simulations," CEA-Saclay, Paris, France 26 February 2009.
5. "Toward Understanding GRB-Supernova Connection by General Relativistic MHD Simulations," IAP, Paris, 2 March 2009.

Invited Seminars (in Japan)

1. "Numerical Study on the Central Engine of Long GRBs," Dept. Astronomy, Kyoto Univ., 20 May 2008.
2. "Asymmetric Supernova Explosion," Dept. Physics, Nagoya Univ., 25 June 2008.
3. "Cosmic Ray Astrophysics," 38th Summer School of Astronomy and Astrophysics, Tsukuba, 29 July 2008.
4. "Current Status of Understanding of Long GRBs and Its Future Prospect," Dept. Physics, Osaka City Univ., 7 November 2008.
5. "Central Engine of Long Gamma-Ray Bursts," Dept. Physics, Univ. of Tokyo, 4 February 2009.

Akira Onishi

Journal Papers

1. C. Ishizuka, A. Ohnishi, K. Tsubakihara, K. Sumiyoshi, S. Yamada, "Tables of Hyperonic Matter Equation of State for Core-Collapse Supernovae," J. Phys. G **35** (2008), 085201 (19 pages), ITP-08-108, arXiv:0802.2318 [nucl-th].
2. K. Sumiyoshi, C. Ishizuka, A. Ohnishi, S. Yamada, H. Suzuki, "Emergence of Hyperons in Failed Supernovae: Trigger of the Black Hole Formation," Astrophys. J. Lett. **690** (2009) L43-L46, YITP-09-78, arXiv:0811.4237 [astro-ph].
3. Teiji Kunihiro, Berndt Müller, Akira Ohnishi, Andreas Schäfer, "Towards a Theory of Entropy Production in the Little and Big Bang," Prog. Theor. Phys. **121** (2009) 555-575, YITP-09-79, arXiv:0809.4831 [hep-ph].

Books and Proceedings

1. R. Mizukawa, T. Hirano, M. Isse, Y. Nara, A. Ohnishi, "Search for a Ridge Structure Origin with Shower Broadening and Jet Quenching," J. Phys. G **35** (2008), 104083 (4 pages) YITP-08-109, arXiv:0805.2795 [nucl-th].
2. K. Miura, N. Kawamoto, A. Ohnishi, "Hadron mass spectrum in strong coupling limit of lattice QCD at finite temperature and density for color SU(3)," Prog. Theor. Phys. Suppl. **174** (2008) 250-253, YITP-08-110.

3. Akira Ohnishi, Kohtaroh Miura, “Quarkyonic phase in the strong coupling region of lattice QCD,” PoS **LATTICE 2008** (2008), 192 (7 pages), YITP-08-111.
4. Kohtaroh Miura, Akira Ohnishi, Noboru Kawamoto, “Strong coupling lattice study of $1/g^2$ evolution in phase diagram and baryon mass,” PoS **LATTICE 2008** (2008), 075 (13 pages), YITP-08-112.

Talks at International Conferences

1. “Quarkyonic Phase in Lattice QCD at Strong Coupling,” in the XXVI International Symposium on Lattice Field Theory (Lattice 2008), Williamsburg, USA, July 14-19, 2008.
2. “Nuclear Matter Equation of State,” Invited, in the 7th CNS-EFES Summer School, August 26-September 1, 2008, CNS, Tokyo, Japan.
3. “Jet-Shower Broadening and Ridge Structure,” Invited, in Tamura Symposium on Heavy-Ion Physics, November 20-22, 2008, Austin, USA.
4. “Evolution of the QCD phase diagram in the Strong Coupling Region of Lattice QCD, Invited,” in Sapporo Winter School 2009, Sapporo, Japan, January 8-9, 2009.

Invited Seminars (in Japan)

1. “Nuclear and Hadron Physics in J-PARC” (in Japanese), in KEK workshop on J-PARC Physics — New stages in Hadron and Nuclear Physics —, KEK, Japan, August 7-9, 2008.
2. “Dense Nuclear Matter” — Strangeness, Lattice, and Heavy-Ion — (series lecture), Dep. of Physics, the Univeristy of Tokyo, October 22-24, 2008.
3. “From quarks to nucleosynthesis” — Origin of matter and mass probed in laboratory experiments — (in Japanese), in Nishinomiya-Yukawa Memorial Seminar, Nishinomiya, Japan, December 6, 2008.
4. “World at 2 Tera K and 1000 Tera g/cc: Phase transition to quark matter” (in Japanese), in Global COE symposium, Kyoto University, Kyoto, February 16-18, 2009.

Misao Sasaki

Journal Papers

1. A. Anabalon, N. Deruelle, Y. Morisawa, J. Oliva, M. Sasaki, D. Tempo and R. Troncoso, “Kerr-Schild ansatz in Einstein-Gauss-Bonnet gravity: An exact vacuum solution in five dimensions,” Class. Quant. Grav. **26**, 065002 (2009) [arXiv:0812.3194 [hep-th]].
2. A. E. Romano and M. Sasaki, “Effects of particle production during inflation,” Phys. Rev. D **78**, 103522 (2008) [arXiv:0809.5142 [gr-qc]].
3. A. Naruko and M. Sasaki, “Large non-Gaussianity from multi-brid inflation,” Prog. Theor. Phys. **121**, 193 (2009) [arXiv:0807.0180 [astro-ph]].
4. M. Sasaki, “Multi-brid inflation and non-Gaussianity,” Prog. Theor. Phys. **120**, 159 (2008) [arXiv:0805.0974 [astro-ph]].
5. J. O. Gong and M. Sasaki, “Curvature perturbation spectrum from false vacuum inflation,” JCAP **0901**, 001 (2009) [arXiv:0804.4488 [astro-ph]].
6. N. Deruelle, M. Sasaki and Y. Sendouda, “‘Detuned’ f(R) gravity and dark energy,” Phys. Rev. D **77**, 124024 (2008) [arXiv:0803.2742 [gr-qc]].
7. N. Sakai and M. Sasaki, “Stability of Q-balls and Catastrophe,” Prog. Theor. Phys. **119**, 929 (2008) [arXiv:0712.1450 [hep-ph]].
8. P. Binetruy, M. Sasaki and K. Uzawa, “Dynamical D4-D8 and D3-D7 branes in supergravity,” Phys. Rev. D **80**, 026001 (2009) [arXiv:0712.3615 [hep-th]].

Books and Proceedings

1. M. Sasaki, “Summary Of Session B4: Early Universe, Pre-Big Bang, Etc,” in Proceedings of GR18, Class. Quant. Grav. **25**, 114021 (2008).

Talks at International Conferences

1. “Delta N formalism and nonlinear curvature perturbations from inflation,” Invited, in L. D. Landau Memorial Conference “Advances in Theoretical Physics, ” Landau Institute, Moscow, 22–26 June 2008.

2. "Multi-brid inflation and non-Gaussianity," Invited, in 13 Russian Gravitational Conference "International Conference on Gravitation, Cosmology and Astrophysics," PFUR, Moscow, 23–28 June 2008.
3. "Large non-gaussianity from multi-brid inflation," Invited, in "Non-Gaussianity from Fundamental Physics," CMS, Cambridge, 8–10 September 2008.
4. "Primordial black hole formation after inflation," Invited, in "Black Holes: Theoretical, Mathematical and Computational aspects," BIRS, Banff, Canada, 10–14 November 2008.
5. "Cosmological perturbations from inflation," Invited lectures, in "APCTP-NCTS International School/Workshop on Gravitation and Cosmology," APCTP, Pohang, Korea, 16–20 January 2009.
6. "Large non-Gaussianity from multi-brid inflation," Invited, in "The 1st APCTP Mini-Workshop on String Theory and Cosmology," APCTP, Seoul, Korea, 21 March 2009.

Invited Seminars (Overseas)

1. "Multi-brid Inflation and Non-Gaussianity," KIAS, Seoul, Korea, 27 May 2008.
2. "Non-Gaussian perturbations from multi-brid inflation," ICG, Portsmouth, UK, 2 October 2008.
3. "Non-Gaussianity from multi-brid inflation," IEU, Ehwa Womans University, Seoul, Korea, 16 March 2009.
4. "Basics of cosmological perturbation theory," CQuest, Sogang University, Seoul, Korea, 17 March 2009.

Invited Seminars (in Japan)

1. "Non-Gaussianity from multi-brid inflation," Dept. Physics, Rikkyo University, 5 December 2008.
2. "Non-Gaussianity from multi-brid inflation," Dept. Physics, Nagoya University, 11 December 2008.

Ryu Sasaki

Journal Papers

1. R. Sasaki, W-L. Yang and Y-Z. Zhang, "Bethe ansatz solutions to quasi exactly solvable difference equations," SIGMA **5** (2009), 104, 16 pages, YITP-08-33, arXiv:0805.0166[math-ph].
2. S. Odake and R. Sasaki, "Crum 's Theorem for ' Discrete ' Quantum Mechanics," Prog. Theor. Phys. **122** (2009) 1067-1079, YITP-09-12 arXiv:0902.2593[math-ph].
3. R. Sasaki, "Exactly Solvable Birth and Death Processes," J. Math. Phys. **50** (2009) 103509 (18 pages), arXiv:0903.3097 [math-ph].

Books and Proceedings

1. Ryu Sasaki, "Heisenber Equations" (in Japanese), Mathematical Science, No. 552 (2009) 24-29.

Talks at International Conferences

1. "Exactly solvable Quantum Mechanics and dynamical symmetry algebras," Invited, Plenary, in "Liouville Gravity and Lattice Statistics, " Poncelet Inst. Moscow, 21–24 June 2008.

Invited Seminars (Overseas)

1. "q-oscillator from the q-Hermite Polynomial," Department of Physics, Shenzeng University, China, 07 April 2009.

Invited Seminars (in Japan)

1. "Exactly Solvable Quantum Mechanics and Dynamical Symmetry Algebras," Dept. Physics, Osaka City Univ., 9 September 2009.

Naoki Sasakura

Journal Papers

1. N. Sasakura, "The lowest modes around Gaussian solutions of tensor models and the general relativity," Int. J. Mod. Phys. A **23** (2008) 3863, [arXiv:0710.0696 [hep-th]].
2. N. Sasakura, "Emergent general relativity on fuzzy spaces from tensor models," Prog. Theor. Phys. **119** (2008) 1029, [arXiv:0803.1717 [gr-qc]].
3. N. Sasakura and S. Watamura, "Noncommutative geometry and quantum spacetime

in physics. Proceedings, 21st Nishinomiya-Yukawa Memorial Symposium on Theoretical Physics, Nishinomiya, Japan, November 11-12, 2006 and Kyoto, Japan, November 13-15, 2006," Prog. Theor. Phys. Suppl. **171** (2007) 1.

Talks at International Conferences

1. "Emergent general relativity in fuzzy spaces from tensor models," in "Fourth International Workshop DICE2008", Castello Pasquini/Castiglioncello (Tuscany), September 22-26, 2008.
2. "Emergence of space, general relativity and gauge theory from tensor models," in "Sapporo Winter School 2009", Hokkaido Univ., 8-9 January, 2009.

Invited Seminars (in Japan)

1. "Emergent general relativity on fuzzy spaces from tensor models," Dept. Physics, Hokkaido Univ., June 13, 2008.
2. "Emergent general relativity in fuzzy spaces from tensor models", Dept. Physics, Univ. of Tokyo, June 19, 2008.

Masaru Shibata

Journal Papers

1. M. Shibata, K. Kyutoku, T. Yamamoto, and K. Taniguchi, "Gravitational waves from black hole-neutron star binaries: Classification of waveforms", Phys. Rev. **D79** (2009) 044030 (27 pages), arXiv:0902.0416.

Ken-ichi Shizuya

Journal Papers

1. T. Misumi and K. Shizuya, "Electromagnetic response and pseudo-zero-mode Landau levels of bilayer graphene in a magnetic field," Phys. Rev. **B 77** (2008) 195423 1-8, arXiv:0803.2452 [cond-mat], YITP-08-15.

Takahiro Tanaka

Journal Papers

1. D. Langlois, S. Renaux-Petel, D. A. Steer and T. Tanaka, "Primordial fluctuations and non-Gaussianities in multi-field DBI inflation," Phys. Rev. Lett. **101** (2008) 061301, arXiv:0804.3139 [hep-th]. YITP-08-31
2. D. Langlois, S. Renaux-Petel, D. A. Steer and T. Tanaka, "Primordial perturbations and non-Gaussianities in DBI and general multi-field inflation," Phys. Rev. D **78** (2008) 063523, arXiv:0806.0336 [hep-th]. YITP-08-56.
3. S. Yokoyama, T. Suyama and T. Tanaka, "Efficient diagrammatic computation method for higher order correlation functions of local type primordial curvature perturbations," JCAP **0902** (2009) 012, arXiv:0810.3053 [astro-ph] YITP-08-81.
4. K. Izumi and T. Tanaka, "Particle production in models with helicity-0 graviton ghost in de Sitter spacetime," Prog. Theor. Phys. **121** (2009) 427 (21 pages), arXiv:0810.4811 [hep-th] YITP-08-113.

Talks at International Conferences

1. "Classical black-hole evaporation conjecture, and floating black holes" Invited, in "Quantum Black Holes, Braneworlds and Holography," IFIC, Valencia, 12-16 May 2008.

Invited Seminars (Overseas)

1. "IR loop-corrections during inflation," Universitat de Barcelona, Spain, 9 May 2008.

Invited Seminars (in Japan)

1. "Classical BH evaporation conjecture and floating black holes," Dept. Physics, Niigata Univ., 26 September 2008.
2. "Non-linear evolution during inflation," Summer Institute 2008, Fujiyoshida, 11 August 2008.

Seiji Terashima

Journal Papers

1. N. Ogawa and S. Terashima, "Coarse-graining of bubbling geometries and the fuzzball conjecture," Phys. Rev. D. **78** (2008) 064029 (7 pages), YITP-08-37, arXiv:0805.1405 [hep-th].

2. H. Fuji, S. Terashima and M. Yamazaki, “A New N=4 Membrane Action via Orbifold,” Nucl. Phys. B. **810** (2009) 354-368 YITP-08-36, arXiv:0805.1997 [hep-th].
3. S. Terashima, “Tachyon Condensation on Torus and T-duality,” JHEP **0810** (2008) 033 (15 pages), YITP-08-44, arXiv:0806.0975 [hep-th].
4. S. Terashima, “On M5-branes in N=6 Membrane Action,” JHEP **0808** (2008) 080 (12 pages), YITP-08-54, arXiv:0807.0197 [hep-th].
5. S. Terashima and F. Yagi, “Orbifolding the Membrane Action,” JHEP **0812** (2008) 041 (34 pages), YITP-08-55, arXiv:0807.0368 [hep-th].

Invited Seminars (Overseas)

1. “On membrane actions,” Helsinki Institute of Physics, University of Helsinki, Finland, 02 July 2008.

Invited Seminars (in Japan)

1. “A New N=4 Membrane Action via Orbifold,” Dept. Physics, Kyushu Univ., 18 July 2008.
2. “Toward a Proof of Montonen-Olive Duality via Multiple M2-branes,” Dept. Physics, Kyoto Univ., 29 October 2008.
3. “Toward a Proof of Montonen-Olive Duality via Multiple M2-branes,” IPMU, The Univ. of Tokyo, 27 November 2008.
4. “On the Fuzzball conjecture,” the Workshop “String theory and Cosmology”, Kinosaki, 18-20 Feburary 2009.
5. “M5-branes in ABJM action,” KEK Theory Workshop 2009, KEK, 16-19 March 2009.

Takami Tohyama

Journal Papers

1. H. Matsueda, A. Ando, T. Tohyama and S. Maekawa, “Enhancement of phonon effects in photoexcited states of one-dimensional Mott insulators,” Phys. Rev. **B77** (2008) 193112, (4 pages), arXiv:0802.3965 [cond-mat].
2. S. Sota and T. Tohyama, “Low-temperature density matrix renormalization group using regulated polynomial expansion,” Phys. Rev. **B78** (2008) 113101, (4 pages), arXiv:0806.3352 [cond-mat].
3. M. Mori, G. Khaliullin, T. Tohyama and S. Maekawa, “Origin of the Spatial Variation of the Pairing Gap in Bi-Based High Temperature Cuprate Superconductors,” Phys. Rev. Lett. **101** (2008) 247003, (4 pages), arXiv:0805.1281 [cond-mat].
4. H. Matsueda, A. Ando, T. Tohyama and S. Maekawa, “Effect of electron-phonon interaction on optical response in one-dimensional cuprates,” J. Phys. Chem. Solids **69** (2008) 3070-3073.
5. K. Ishii, M. Hoesch, T. Inami, K. Kuzushita, K. Ohwada, M. Tsubota, Y. Murakami, J. Mizuki, Y. Endoh, K. Tsutsui, T. Tohyama, S. Maekawa, K. Yamada, T. Masui, S. Tajima, H. Kawashima, and J. Akimitsu, “Momentum-resolved charge excitations in high-Tc cuprates studied by resonant inelastic X-ray scattering,” J. Phys. Chem. Solids **69** (2008) 3118-3124.
6. T. Tohyama, “Spectral function and dynamical spin correlation function in the t-t’-t”-J model,” J. Phys. Chem. Solids **69** (2008) 3176-3180.
7. K. Tsutsui, A. Toyama, T. Tohyama and S. Maekawa, “Exact diagonalization study on nonmagnetic impurity effects in high-Tc superconductors,” J. Phys. Chem. Solids **69** (2008) 3365-3368.
8. T. Tohyama and H. Matsueda, “Effect of electron-phonon interaction on optical response in one-dimensional cuprates,” Prog. Theor. Phys. Suppl. **176** (2008) 165-181.
9. T. Morinari, T. Himura and T. Tohyama, “Possible Verification of Tilted Anisotropic Dirac Cone in alpha-(BEDT-TTF)2I3 Using Interlayer Magnetoresistance,” J. Phys. Soc. Jpn. **78** (2009) 023704 (4 pages), arXiv:0811.3041 [cond-mat].

Talks at International Conferences

1. “Resonant and Non-Resonant IXS: Theory,” in “A Next-Generation Beamline for Inelastic X-Ray Scattering, ” SPring-8, Japan, 22–23 May 2008.
2. “Dynamical DMRG Study of Hubbard-Holstein Model in One Dimension,” Invited, in “The 1st International Conference of the Grand Challenge to Next-Generation Inte-

grated Nanoscience, " Tokyo, Japan, 3–7 June 2008.

3. "Spatial Variation of Pairing Gap in Bi-Based High-Tc Cuprates," Invited, in "International Conference on Stripes (STRIPES2008), " Erice, Italy, 27 July–1 August 2008.
4. "Strong Correlation Effects in Cuprates as Evidenced from Single-Particle and Charge Excitations," Invited, in "Inelastic Neutron and X-Ray Scattering in Strongly Correlated Electron Systems, "Sendai, Japan, 1–3 October 2008.
5. "Dynamical DMRG study of one-dimensional Hubbard-Holstein model," Invited, in "Supercomputing in Solid State Physics 2009 (SciSSP2009), " Kashiwa, Japan, 16–19 February 2009.

Invited Seminars (Overseas)

1. "Effect of electron-phonon interaction on optical properties in one-dimensional Mott insulators," Josph Stephan Institute, Ljubliana, Slovania, 10 April 2008.

Keisuke Totsuka

Journal Papers

1. A. Tanaka, K. Totsuka, and X. Hu, "Geometric phases and the magnetization process in quantum antiferromagnets," Phys. Rev. B, **79** (2008) 064412 (16 pages), arXiv:0712.4316 [cond-mat].

Talks at International Conferences

1. "Geometric approach to magnetization plateaus", in "Topological Aspects of Solid State Physics," Institute of Solid State Physics and Yukawa Institute for Theoretical Physics, Japan, 22–27 June 2008.
2. "Magnon BEC and Unconventional Quantum Orders," in "Highly Frustrated Magnetism 2008", Technical University Brunswick, Germany, 7-12 September 2008.

Talks at Other Conferences and Workshops

1. "Z_2-gauge theory approach for spin systems in strong magnetic fields and fractionalization," in Autumn Meeting of the Physical Society of Japan', Iwate University, Japan, 22 September 2008.
2. "Possible featureless spin liquid states in high magnetic fields –magnetization plateaus with fractionalized excitations," in "Frustration and Spin Liquids", Kobe University, Japan, 22 December 2008.
3. "Magnetic Structures of Frustrated Magnets in High Magnetic Fields –an approach from magnon BEC," in annual meeting of the project "Novel States of Matter Induced by Frustration", Institute of Solid State Physics, Japan, 7-9 January 2009.

Invited Seminars (Overseas)

1. "Possible Featureless Spin Liquid Phases in High Magnetic Fields –Magnetization Plateaus Revisited," LPTMC, University Pierre and Marie Curie (Paris VI), 19 March 2009.

Invited Seminars (in Japan)

1. "Magnetization Plateaus Revisited – an approach from geometrical viewpoint," Dept. Physics, Tohoku University, 24 July 2008.

Hirofumi Wada

Journal Papers

1. H. Wada, "A semiflexible polymer ring acting as a nano-propeller," Eur. Phys. J. E **28** (2008) 11-16.
2. H-R. Jiang, H. Wada, N. Yoshinaga and M. Sano, "Manipulation of colloids by nonequilibrium depletion force under temperature gradients," Phys. Rev. Lett. **102** (2009) 208301.

Invited Seminars (in Japan)

1. "Elastic helical filaments: Brownian dynamics study," Dept. Chemical Engineering, Kyoto Univ., 13 May 2008.
2. "Design principle of microscopic life from hydrodynamics," Dept. Polymer Science, Hokkaido Univ., 27 June 2008.

2.3.3 Publications and Talks by Research Fellows and Graduate Students (April 2008– March 2009)

Hiroyuki Abe

Journal Papers

1. H. Abe, T. Higaki and T. Kobayashi and O. Seto, "Non-perturbative moduli superpotential with positive exponents," Phys. Rev. **D78** (2008) 025007, 8 pages, arXiv:0804.3229 [hep-th], YITP-08-28.
2. H. Abe, T. Kobayashi and H. Ohki, "Magnetized orbifold models," JHEP **0809** (2008) 043, 21 pages, arXiv:0806.4748 [hep-th], YITP-08-48.
3. H. Abe and Y. Sakamura, "Flavor structure with multi moduli in 5D supergravity," Phys. Rev. **D79** (2009) 045005, 16 pages, arXiv:0807.3725 [hep-th], YITP-08-64.
4. H. Abe, T. Higaki, T. Kobayashi, K. Ohta, Y. Omura and H. Terao, "Duality cascade of softly broken supersymmetric theories," Phys. Rev. **D79** (2009) 045003, 11 pages, arXiv:0810.5451 [hep-th], YITP-08-83.

Talks at International Conferences

1. "Sequestering in models of F-term uplifting," The 14th International Symposium on Particles, Strings and Cosmology (PASCOS 2008), 2–6 June 2008, Waterloo, Canada.
2. "Sequestering in models of F-term uplifting," The 16th International Conference on Supersymmetry and the Unification of Fundamental Interactions (SUSY 2008), 16–21 June 2008, Seoul, Korea.

Invited Seminars (in Japan)

1. "Phenomenological aspects of nonperturbative moduli stabilization and uplifting," 13 May 2008, KEK, Tsukuba.
2. "Flavor issues in nonperturbative moduli stabilization" (in Japanese), 22 Sep 2008, JPS autumn meeting, Yamagata University, Yamagata.

Cecilia Albertsson

Journal Papers

1. C. Albertsson, T. Kimura and R. A. Reid-Edwards, "D-branes and doubled geometry," JHEP **0904** (2009) 113 (39 pages), arXiv:0806.1783 [hep-th], YITP-08-39.

Talks at International Conferences

1. "Doubled geometry and string theory," Invited, in "Supersymmetry in complex geometry" workshop, Institute for the Physics and Mathematics of the Universe (IPMU), University of Tokyo, Japan, 5–9 January 2009.

Invited Seminars (Overseas)

1. "Doubled geometry and string theory," Institute for Theoretical Physics, Leibniz Universität Hannover, Hannover, Germany, 30 April 2008.

Invited Seminars (in Japan)

1. "Doubled geometry and string theory," Theoretical Physics Laboratory, RIKEN, Wako, 17 June, 2008.
2. "Doubled geometry and string theory," Department of Physics, Nagoya University, Nagoya, 15 December, 2008.

Junichi Aoi

Talks at International Conferences

1. "The acceleration and radiation in the internal shock of the gamma-ray bursts," "TeV Particle Astrophysics 2008, " Plenary, 24-28 September 2008, Beijing, China.

Antonino Flachi

Journal Papers

1. A. Flachi, M. Minamitsuji, "Field localization on a brane intersection in anti-de Sitter spacetime," Phys. Rev. **D79** 104021 (2009), arXiv:0903.0133 [hep-th].

2. E. Bilgici, A. Flachi, E. Itou, M. Kurachi, C.-J.D. Lin, H. Matsufuru, H. Ohki, T. Onogi, T. Yamazaki, “A new scheme for the running coupling constant in gauge theories using Wilson loops,” Phys. Rev. **D80** (2009) 034507, arXiv:0902.3768 [hep-lat].
3. A. Flachi, M. Sasaki, T. Tanaka, “Spin-Polarization effects in micro black hole evaporation,” JHEP **05** (2009) 031, arXiv:0809.1006 [hep-ph].

Books and Proceedings

1. A. Flachi, M. Sasaki, T. Tanaka, “Evaporation of Micro Black Holes,” proceedings of the International Conference, ‘Progress in Particles Physics 2008’ (YKIS 16), (in Soryushiron Kenkyu, 2009).
2. A. Flachi, M. Sasaki, T. Tanaka, “Signatures of Spinning Evaporating Micro Black Holes,” Procs. of JGRG18 (2008) 41.
3. E. Bilgici, A. Flachi, E. Itou, M. Kurachi, C.-J.D. Lin, H. Matsufuru, H. Ohki, T. Onogi, T. Yamazaki, “A New method of Calculating the Running of the Coupling Constant,” arXiv:0808.2875 [hep-lat], PoS (LATTICE 2008) 247.

Talks at International Conferences

1. “Micro black holes at the LHC” (invited), at the “International Workshop on Cosmology and Particle Physics’ Kavli Institute for Theoretical Physics, Chinese Academy of Science, Beijing, March 2009.
2. “Field Localization on brane intersections in anti-de Sitter space,” International Symposium on Topological Science and Technology for young researchers, Sapporo University (Japan), March 2009.
3. “Spin-Polarization Effects in Micro Black Hole Evaporation,” at 16th International Conference, ‘Progress in Particles Physics 2008’ (YKIS 16), Kyoto University, February 2009.
4. “Signatures of spinning evaporating micro black holes,” at 18th Japanese Meeting on General Relativity and Gravitation (JGRG18), Hiroshima University, November 2008.
5. “Spin patterns in micro black hole evaporation” invited, at Fuji-Yoshida Particle Physics Summer Institute, August 2008.
6. “Evaporation of rotating micro black holes,” invited, at the International Workshop ‘Quantum Black Holes, Brane Worlds and Holography’, University of Valencia, May 2008.

Invited Seminars (Overseas)

1. “Evaporation of micro black holes,” Center for Quantum Spacetime (CQUeST), Sogang University, Seoul, Korea, January 2009.

Invited Seminars (in Japan)

1. “Signatures of spinning evaporating micro black holes,” Mini-workshop ‘Brainstorming on higher dimensional black holes’, Yukawa Institute for theoretical Physics, Kyoto, October 2008.

Nobuo Hinohara

Books and Proceedings

1. N. Hinohara, T. Nakatsukasa, M. Matsuo and K. Matsuyanagi, “Microscopic Dynamics of Shape Coexistence Phenomena around ^{68}Se and ^{72}Kr”, Proceedings of International Symposium on Physics of Unstable Nuclei (ISPUN07), Hoi An, Vietnam, 3-7 July 2007, World Scientific, (2008) 373-393, arXiv:0709.3897 [nucl-th].
2. N. Hinohara, T. Nakatsukasa, M. Matsuo and K. Matsuyanagi, “Microscopic Dynamics of Shape Coexistence Phenomena around ^{68}Se and ^{72}Kr,” Proceedings of Fourth International Conference on Fission and Properties of Neutron-Rich Nuclei, Sanibel Island, Florida, USA, 11-17 November 2007, World Scientific, (2008) 623-630.

Talks at International Conferences

1. “Microscopic description of shape coexistence/mixing phenomena in the $A = 80-100$ region,”
CNS-RIKEN Joint International Symposium on Frontier of gamma-ray spectroscopy and Perspectives for Nuclear Structure Studies (gamma08), 3-6 April 2008, RIKEN Nishina Center, Wako, Japan.
2. “Large-amplitude collective dynamics of shape coexisntence/mixing phenomena in

the $A = 80 - 100$ region,"
Nuclear Structure 2008 (NS2008), 3-6 June 2008, Michigan State University, East Lansing, Michigan, USA.
3. "Large-amplitude collective dynamics of shape coexistence/mixing phenomena in proton-rich Ge, Se, Kr and Zr isotopes," JUSTIPEN presymposium "Frontier in Unstable Nuclear Physics," 18-19 July 2008, Hokkaido University, Sapporo, Japan.
4. "Microscopic description of oblate-prolate shape mixing in proton-rich Se isotopes," The 3rd LACM-EFES-JUSTIPEN Workshop, 23-25 February 2009, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA.

Tetsuo Hyodo

Journal Papers

1. A. Doté, Tetsuo Hyodo, Wolfram Weise, "Variational calculation of the ppK^- system based on chiral SU(3) dynamics," Phys. Rev. **C79** (2009) 014003 (16 pages), arXiv:0806.4917 [nucl-th], YITP-08-60.

Books and Proceedings

1. Takayasu Sekihara, Tetsuo Hyodo, Daisuke Jido, "Electromagnetic Mean Squared Radii of $\Lambda(1405)$ in Meson-baryon Dynamics with Chiral Symmetry," Prog. Theor. Phys. Suppl. **174** (2008) 266-269, arXiv:0807.2091 [nucl-th], YITP-08-62.
2. A. Doté, Tetsuo Hyodo, Wolfram Weise, "The ppK^- system studied with a chiral SU(3) based potential," Mod. Phys. Lett. A **23** (2008) 2532-2535.

Talks at International Conferences

1. "Effective $\bar{K}N$ interaction in chiral SU(3) dynamics," Invited, Plenary, International Conference on Exotic Atoms (EXA2008), Stefan-Meyer-Inst. Wien, 15–18 September 2008.
2. "$\Lambda(1405)$ in chiral dynamics," Plenary, Workshop on Hadron Dynamics (HADRON2008), Almunecar, Spain, 25–28 September 2008.
3. "$\Lambda(1405)$ in chiral dynamics," Plenary, Japanese French Symposium New paradigms in Nuclear Physics, Inst. Henri Poincaré, Paris, 29 September–2 October 2008.

Hideaki Iida

Journal Papers

1. A. Yamamoto, H. Suganuma, and H. Iida, "Heavy-heavy-light quark potential in SU(3) lattice QCD," Phys. Lett. **B664** (2008) 129-132, arXiv:0708.3610 [hep-lat].
2. A. Yamamoto, H. Suganuma, and H. Iida, "Lattice QCD study of the heavy-heavy-light quark potential," Phys. Rev. D**78** (2008) 014513, arXiv:0806.3554 [hep-lat].

Books and Proceedings

1. A. Yamamoto, H. Suganuma, and H. Iida, "Heavy-heavy-light quark potential in two approaches," Prog. Theor. Phys. Suppl. **174** (2008) 270-273, arXiv:0805.4735 [hep-lat].
2. H. Iida, Toru T. Takahashi, and H. Suganuma, "Properties of Scalar-Quark Systems in $\mathrm{SU}(3)_c$ Lattice QCD," Mod. Phys. Lett. A**23** (2008) 2344-2347, arXiv:0810.1115 [hep-lat].
3. H. Iida, T. Doi, N. Ishii, H. Suganuma, and K. Tsumura, "Survival of charmonia above T_c in anisotropic lattice QCD," Prog. Theor. Phys. Suppl. **174** (2008) 238-241, arXiv:0806.0126 [hep-lat].
4. H. Suganuma, A. Yamamoto, N. Sakumichi, T. T. Takahashi, H. Iida, and F. Okiharu, "Inter-Quark Potentials in Baryons and Multi-Quark Systems in QCD," Mod. Phys. Lett. **A**23 (2008) 2331-2339, arXiv:0802.3500 [hep-ph].

Talks at International Conferences

1. "Three-quark systems in MA and MC projected QCD", in "The XXI International Symposium on Lattice Field Theory", College of Willam and Mary, Williamsburg, Virginia, USA, July 2008.

Etsuko Itou

Journal Papers

1. T. Higashi, E. Itou and T. Kugo, "The BV master equation for the Wilson action in general Yang-Mills gauge theory," Proceedings of Workshop On Progress Of String Theory And Quantum Field Theory, 7-10 Dec 2007, Osaka, Japan, Int. J. Mod. Phys. **A23** (2008) 2255-2256.

Books and Proceedings

1. Erek Bilgici, Antonino Flachi, Etsuko Itou, Masafumi Kurachi, C.-J David Lin, Hideo Matsufuru, Hiroshi Ohki, Tetsuya Onogi, Takeshi Yamazaki, "A New Method of Calculating the Running Coupling Constant," Proceedings of The XXVI International Symposium on Lattice Field Theory, arXiv:0808.2875 [hep-lat], 13pages.

Talks at International Conferences

1. "A new method of calculating the running coupling constant – numerical results –," in "The XXVI International Symposium on Lattice Field Theory , "College of William and Mary, Virginia, USA, 14–19 July 2008.
2. "The BV Master Equation for the Gauge Wilson Action," in "4th International Conference on the Exact Renormalization Group", Heidelberg, Germany, 01-06 July 2008.

Invited Seminars (in Japan)

1. "A new method of calculating the running coupling constant – quenched QCD test –," Dept. Physics, Osaka City Univ., 23 July 2008.
2. "The BV Master Equation for the Wilson Action in general Yang-Mills Gauge Theory," Dept. Physics, Niigata Univ., 19 June 2008.

Tetsuji Kimura

Journal Papers

1. T. Kimura, "Index theorems on torsional geometries," Int. J. Mod. Phys. A **23** (2008) 2260.

Talks at International Conferences

1. "Generalized Geometries in String Compactification Scenarios," Invited, Plenary, in "Noncommutative Geometry and Physics 2009," Keio University, 18–21 February 2009.

Invited Seminars (in Japan)

1. "Generalized/doubled/nongeometric string backgrounds," Theory Division, IPNS, KEK, 5 June 2008.
2. "Supergravity and doubled geometry," YITP Workshop "Quantum Field Theory and String Theory," Yukawa Institute, 30 July 2008.
3. "Generalized/doubled/nongeometric string backgrounds," Dept. Physics, Osaka Univ., 5 August 2008.
4. "D-branes and doubled geometry," JPS Meeting, Yamagata Univ., 20 September 2008.
5. "Realization of AdS vacua in attractor mechanism on generalized geometry," Theoretical Physics Laboratory, RIKEN, 10 November 2008.
6. "Realization of AdS vacua in attractor mechanism on generalized geometry," Institute of Physics, Univ. Tokyo, Komaba, 12 November 2008.
7. "Realization of AdS vacua in attractor mechanism on generalized geometries," GCOE Program, Dept. Physics, Nagoya Univ., 27 November 2008.
8. "Realization of AdS vacua on generalized geometry," KEK Workshop "Heterotic String and M Theory," Theory Division, IPNS, KEK, 2 December 2008.
9. "Realization of AdS vacua in attractor mechanism on generalized geometries," RIKEN Symposium "Towards New Developments in Field and String Theories," RIKEN, 20 December 2008.
10. "Realization of AdS vacua on generalized geometries," Dept. Physics, Osaka Univ., 24 February 2009.
11. "AdS Vacua, Attractor Mechanism and Generalized Geometries," IPMU, 5 March 2009.
12. "Realization of AdS Vacua in Attractor Mechanism on Generalized Geometry," JPS Meeting, Rikkyo Univ., 30 March 2009.

Masafumi Kurachi

Journal Papers

1. R. S. Chivukula, H. J. He, M. Kurachi, E. H. Simmons and M. Tanabashi, "General Sum Rules for WW Scattering in Higgsless Models: Equivalence Theorem and Deconstruction Identities," Phys. Rev. **D78** (2008) 095003, YITP-08-67, [arXiv:0808.1682 [hep-ph]].

Books and Proceedings

1. M. Kurachi, "A three site Higgsless model," AIP Conf. Proc. **1015**, 219 (2008).

Talks at International Conferences

1. "A New Method of Calculating the Running Coupling Constant — theoretical formulation" 26th International Symposium on Lattice Field Theory (Lattice 2008), Williamsburg, Virginia, 14-20 Jul 2008. e-Print: arXiv:0808.2875 [hep-lat].

Kohtaroh Miura

Books and Proceedings

1. Kohtaroh Miura, Noboru Kawamoto and Akira Ohnishi, "Hadron mass spectrum in strong coupling limit of lattice QCD at finite temperature and density for color SU(3)," Prog. Theor. Phys. Suppl. **174** (2008) 250-253, YITP-08-110.
2. Kohtaroh Miura, Akira Ohnishi and Noboru Kawamoto, "Strong coupling lattice study of $1/g^2$ evolution in phase diagram and baryon mass," Proc. Sci. **LATTICE 2008** (2008), 075 (13 pages), YITP-08-112.
3. Akira Ohnishi and Kohtaroh Miura, "Quarkyonic phase in the strong coupling region of lattice QCD," Proc. Sci. **LATTICE 2008** (2008), 192 (7 pages), YITP-08-111.

Talks at International Conferences

1. "Strong coupling lattice study of $1/g^2$ evolution in phase diagram and baryon mass," in the XXVI International Symposium on Lattice Field Theory (Lattice 2008), Williamsburg, USA, July 14-19, 2008.
2. "Strong Coupling Lattice Study for QCD Phase Diagram," at "Fundamental Challenges in QCD", held in Schladming, Austria, March 6(Fri), 2009.

Invited Seminars (in Japan)

1. "Status of Strong Coupling Lattice QCD in Exploring QCD Phase Diagram," in workshop "Phase structure in QCD, recent development and perspective" 12/26(Fri), 2008 at Theoretical Nuclear Physics Group, Kyusyu University.
2. "Chiral phase transition in Strong coupling lattice QCD at finite T and μ for color SU(3)," (2008 1/31(Thu)) Hadron Physics Group, Saga University.
3. "Strong coupling expansion $(1/g^2)$ effects for Phase diagram in strong coupling lattice QCD at finite T and μ," 6/17(Fri) 2008, Seminar at Quantum Hadron Group, Hongo in Tokyo University.

Masaki Murata

Journal Papers

1. M. Fujita, K. Fukushima, T. Misumi and M. Murata, "Finite-temperature spectral function of the vector mesons in an AdS/QCD model," Phys. Rev. **D80** (2009) 035001, arXiv:0903.2316 [hep-ph], YITP-09-19.

Invited Seminars (in Japan)

1. "Static properties of nucleons in Sakai-Sugimoto model," Dept. Physics, University of Tokyo, Komaba, 12 June 2008.

Atsushi Naruko

Journal Papers

1. A. Naruko and M. Sasaki, "Large non-Gaussianity from multi-brid inflation," Prog. Theor. Phys. **121** (2009) 193-210, YITP-08-58, arXiv:0807.0180[astro-ph].

Talks at International Conferences

1. "Large non-Gaussianity from multi-brid inflation," Cosmology and Particle Astrophysics 2008, Asia Pacific Center for Theoretical Physics, Korea, 29-31 October 2008.
2. "Large non-Gaussianity from multi-brid inflation," The 18th Workshop on General Relativity and Gravitation in Japan, Hiroshima University, Hiroshima, Japan, 17-21 November 2008.

Noriaki Ogawa

Journal Papers

1. N. Ogawa and S. Terashima, "Coarse-graining of bubbling geometries and fuzzball conjecture," Phys. Rev. D **78** (2008) 064029, YITP-08-37, arXiv:0805.1405 [hep-th].
2. T. Azeyanagi, N. Ogawa and S. Terashima, "Holographic Duals of Kaluza-Klein Black Holes," JHEP **0904** (2009) 061, YITP-08-88, arXiv:0811.4177 [hep-th].
3. T. Azeyanagi, N. Ogawa and S. Terashima, "The Kerr/CFT Correspondence and String Theory," Phys. Rev. D **79** (2009) 106009, YITP-08-99, arXiv:0812.4883 [hep-th].
4. T. Azeyanagi, G. Compere, N. Ogawa, Y. Tachikawa and S. Terashima, "Higher-Derivative Corrections to the Asymptotic Virasoro Symmetry of 4d Extremal Black Holes," Prog. Theor. Phys. **122** (2009) 355, YITP-09-20, arXiv:0903.4176 [hep-th].

Invited Seminars (in Japan)

1. "Coarse-graining of bubbling geometries and fuzzball conjecture," Dept. Physics, Hongo, Univ. of Tokyo, 29 May 2008.
2. "Coarse-graining of bubbling geometries and fuzzball conjecture," Dept. Physics, Osaka City Univ., 5 June 2008.
3. "On the fuzzball conjecture for black holes," Dept. Physics, Tsukuba Univ., 26 September 2008.
4. "On the fuzzball conjecture for black holes," Dept. Physics, Komaba, Univ. of Tokyo, 10 December 2008.

Mitsuhisa Ohta

Journal Papers

1. H. Kunitomo and M. Ohta, "Supersymmetric AdS_3 solutions in Heterotic Supergravity," Prog. Theor. Phys. **122** (2009) 631-657, arXiv:0902.0655 [hep-th], YITP-09-06.

Talks at International Conferences

1. "AdS3 Geometry of Heterotic Supergravity," in "Heterotic string and M theory" KEK, Tsukuba, 2–3 Dec 2008.

Norichika Sago

Journal Papers

1. L. Barack and N. Sago, "Gravitational Self-Force Correction to the Innermost Stable Circular Orbit of a Schwarzschild Black Hole," Phys. Rev. Lett. **102** (2009) 191101, arXiv:0902.0573 [gr-qc].

Kuniyasu Saitoh

Invited Seminars (in Japan)

1. "Wetting transition of a nanocluster deposited on a solid surface," ACP workshop, University of Tokyo, 30 January, 2009.
2. "Wetting transition of a nanocluster deposited on a solid surface," at Phase transition dynamics research group, Kyoto University, 10 March, 2009.

Yuya Sasai

Journal Papers

1. Y. Sasai and N. Sasakura, "The Cutkosky rule of three dimensional noncommutative field theory in Lie algebraic noncommutative spacetime," JHEP **0906**, 013 (2009) arXiv:0902.3050 [hep-th].

Books and Proceedings

1. Y. Sasai and N. Sasakura, "Domain wall solitons and Hopf algebraic translational symmetries in noncommutative field theories," Int. J. Mod. Phys. A **23**, 2277 (2008).

Talks at International Conferences

1. "Domain wall solitons and Hopf algebraic translational symmetries in noncommutative field theories," Plenary, Noncommutative Deformation of Special Relativity, International Centre for Mathematical Sciences, Edinburgh, UK, July 7-11, 2008.

Invited Seminars (in Japan)

1. "Noncommutative field theories and Hopf algebraic symmetries," Tohoku University, Miyagi, May 1, 2008.
2. "Noncommutative field theories and Hopf algebraic symmetries," Osaka University, Osaka, June 10, 2008.

3. "Domain wall solitons and Hopf algebraic translational symmetries in noncommutative field theories," Yukawa Institute for Theoretical Physics, Kyoto, July 29, 2008.
4. "Noncommutative field theories and Hopf algebraic symmetries," Hokkaido University, Hokkaido, October 3, 2008.

Shigetoshi Sota

Journal Papers

1. S. Sota and T. Tohyama, Low-temperature density matrix renormalization group using regulated polynomial expansion, Phys. Rev. **B78** (2008) 113101 (4 pages), arXiv:0806.3352 [quant-ph].

Talks at International Conferences

1. "Low-temperature density matrix renormalization group using regulated polynomial expansion," 2009 APS March Meeting, 16-20 March 2008, Pittsburgh, Pennsylvania.

Toru T. Takahashi

Journal Papers

1. Güray Erkol, Makoto Oka and Toru T. Takahashi, "Pseudoscalar-meson–octet-baryon coupling constants in two-flavor lattice QCD," Phys. Rev. **D79** (2009) 074509, arXiv:0805.3068[hep-lat].

Books and Proceedings

1. Toru T. Takahashi and Teiji Kunihiro, "Two-flavor lattice QCD study of the axial charges of N(1535) and N(1650)," Proceedings of QCD08, Nucl. Phys. **B** (Proc. Suppl.) **186** (2009) 113, arXiv:0911.2543 [hep-lat].

Talks at International Conferences

1. "Two-flavor lattice QCD study of the axial charges of N(1535) and N(1650)," in QCD08, 14th International QCD Conference, 7-12th July, 2008, Montpellier, France.

Invited Seminars (in Japan)

1. "Axial charges of N(1535) and N(1650) in lattice QCD," Dept. Physics, Nagoya Univ., 17 June 2008.
2. "Axial charges of N(1535) and N(1650) in lattice QCD," Dept. Physics, Tsukuba Univ., 20 June 2008.

Takashi Umeda

Talks at International Conferences

1. "Quarkonium correlators at finite temperature", Invited, in International Workshop on Heavy Quarkonia 2008 (QWG2008), Nara Women's University, Japan, 2–5 December 2008.
2. "Lattice study of charmonia in Hot QCD", Invited, in Mini-Workshop on Photons and Leptons in Hot/Dense QCD, Nagoya University, Japan, 2-4 March 2009.

Futoshi YAGI

Journal Papers

1. S. Terashima and F. Yagi, "Orbifolding the Membrane Action," JHEP **0812** (2008) 041, arXiv:0807.0368 [hep-th].

Talks at International Conferences

1. "Orbifolding the membrane action," in "Taiwan String Theory Workshop 2009, " National Taiwan University, Taiwan, 19-21 January 2009.

Invited Seminars (Overseas)

1. "Orbifolding the membrane action," String Focus Group, (National Taiwan University), Taiwan, 09 January 2009.
2. "Seiberg duality and a-maximization," National Center for Theoretical Physics, (National Tsing Hua University), Taiwan, 13 January 2009.

Invited Seminars (in Japan)

1. "A-D-E Quivers and Baryonic Operators" (in Japanese), Department of Physics, Osaka City University, Osaka 13 May 2008.
2. "Orbifold of the Membrane Theory" (in Japanese), Department of Physics, Hokkaido University, Sapporo 29 October 2008.

Daisuke Yamauchi

Talks at International Conferences

1. "The effect of higher curvature correlation in cosmology," in "Japan Physical Society Meeting", Yamagata University, Japan, 20–23 September 2008.
2. "Open Inflation in String Landscape," in "Cosmology and Particle Astrophysics 2008", Pohang International Center/APCTP, Korea, 28 October–1 November 2008.
3. "Open Inflation in String Landscape," in "The 18th Workshop on General Relativity and Gravitation in Japan", Hiroshima University, Japan, 17–21 November 2008.
4. "Open Inflation in String Landscape - Evolutionary effects inside bubble-," in "Japan Physical Society Meeting", Rikkyo University, Japan, 27–30 March 2008

Invited Seminars (in Japan)

1. "Evolutionary effects in one-bubble open inflation for string landscape," Dept. Physics, Nagoya University, 11 March 2009.

Takeshi Yamazaki

Journal Papers

1. S. Sasaki and T. Yamazaki, "Lattice study of flavor SU(3) breaking in hyperon beta decay," Phys. Rev. D**79** (2009) 074508, 24 pages, arXiv:0811.1406[hep-lat], YITP-08-86.
2. T. Yamazaki, Y. Aoki, T. Blum, H. W. Lin, S. Ohta, S. Sasaki, R. J. Tweedie, and J. M. Zanotti (RBC and UKQCD Collaborations), "Nucleon form factors with 2+1 flavor dynamical domain-wall fermions," Phys. Rev. D**79** (2009) 114505, 20 pages, arXiv:0904.2039[hep-lat], YITP-08-100.

Books and Proceedings

1. S. Ohta and T. Yamazaki (RBC and UKQCD Collaborations), "Nucleon structure with dynamical (2+1)-flavor domain wall fermions lattice QCD," Proceedings of Science(**LATTICE 2008)** (2008) 168, 14 pages, arXiv:0810.0045 [hep-lat], YITP-08-74.

Talks at International Conferences

1. "Nucleon form factors with 2+1 flavor domain wall QCD," Invited, Perspectives and challenges for full QCD lattice calculations, European Centre for Theoretical Studies in Nuclear Physics and Related Areas, Torent, Italy, 5–9 May 2008.
2. "Nucleon form factors from dynamical N_f=2+1 domain wall fermions," the XXVIth International Symposium on Lattice Field Theory (Lattice 2008), College of William and Mary, Virginia, USA, 14–19 June 2008.

Invited Seminars (in Japan)

1. "$\Delta I = 3/2$ kaon weak matrix elements with non-zero total momentum lattice," YITP, Kyoto University, Kyoto, 16 April 2008.
2. "Non-perturbative determination of running coupling with twisted Polyakov loop calculation," Department of Physics, University of Tsukua, Tsukuba, 12 September 2008.
3. "Isovector nucleon form factors and structure functions from $N_f = 2 + 1$ dynamical domain wall fermions," Department of Physics, Tokyo Institute of Technology, Tokyo, 6 November 2008.
4. "$\Delta I = 3/2$ kaon weak matrix elements with non-zero total momentum lattice," Department of Physics, Kyushu University, Fukuoka, 28 November 2008.

Chul-Moon Yoo

Journal Papers

1. C-M. Yoo, H. Ishihara, K. Nakao and H. Tagoshi, "Magnification Probability Distribution Functions of Standard Candles in a Clumpy Universe," Prog.Theor. Phys. **120** (2008) 961-983,YITP-07-77, arXiv:0711.2720 [astro-ph].
2. C-M Yoo, T. Kai and K. Nakao, "Solving Inverse Problem with Inhomogeneous Universe," Prog.Theor.Phys. **120** (2008) 937-960,YITP-08-61, arXiv:0807.0932 [astro-ph].

2.4 Seminars, Colloquia and Lectures

▷ 2008.4.1 — 2009.3.31

4.1 Nic Shannon (University of Bristol): How to Have Fun with Frustrated Ferromagnets

4.4 Serguey Petcov (SISSA/INFN/INRNE): Neutrino Masses, Mixing, Dirac and Majorana Leptonic CP-Violation and Leptogenesis

4.9 Futoshi Yagi (YITP): A-D-E Quivers and Baryonic Operators

4.10 Kim Hyeon-Deuk (RIKEN): Ultrafast Exciton Dyanmics in Biomolecules: a Light Harvesting Antenna and a DNA Duplex Helix

4.11 Stefan G. Frauendorf (Res. Cent. Dresden -Rossendorf, University of Notre Dame): Spontaneous Symmetry Breaking and Appearance of Quantal Rotation in Nuclei

4.16 Takeshi Yamazaki (YITP): $\Delta I = 3/2$ Kaon Weak Matrix Elements with Non-zero Total Momentum Lattice

4.17 Takami Hajime (University of Tokyo): Toward unraveling the sources of the highest energy cosmic rays from their arrival distribution

4.17 Hayato Chiba (Kyoto University): Extension and Unification of Traditional Singular Perturbation Methods for ODEs

4.18 Kohtaroh Miura (YITP): Chiral Phase Transition in Strong Coupling Lattice QCD: Strong Coupling Expansion ($1/g^2$) Effects for Phase Diagram

4.23 Masahito Yamazaki (Univ. of Tokyo): Intersecting Solitons, Amoeba and Tropical Geometry

4.23 Nobuo Hinohara (YITP): Microscopic Description of Shape Coexistence Phenomena by Means of the Adiabatic Self-Consistent Collective Coordinate Method

4.24 Michio Otsuki (YITP): Long-range Correlations in Sheared Granular Fluids

5.8 Hiroaki Katsuragi (Kyushu University): Flow Speed, Fluctuation, and Dynamical Heterogeneity in a Granular Heap Flow

5.9 Kazumi Okuyama (Shinshu Univ.): $N = 4$ SYM on K3 and the AdS(3)/CFT(2) Correspondence

5.14 Shuntaro Nakamura (Tohoku University): Axionic Mirage Mediation

5.19 Martin Lemoine (Institut d' Astrophysique de Paris): Origin and Propagation of Ultra-high Energy Cosmic Rays

5.19 Ewald Müller (Max-Planck Institute for Astrophysics): Core Collapse Supernovae and their Gravitational Wave Signal

5.22 Masaomi Ono (Kyushu University): 56Ni Production Due to Magneto-driven Jets from a Collapsar

5.22 Sanjay Jhingan (Center for Theoretical Physics, A Central University): Gravitational Collapse

5.23 Anatoli Afanasjev (Mississippi State University): Time-odd Mean Fields in the Density Functional Theories

5.26 Michael Engel (Institute for Theoretical and Applied Physics, University of Stuttgart): Complex Crystals and Quasicrystals in a Simple Model System

5.28 Akira Ohnishi (YITP): YITP Colloquium: Nuclear Density Functional from QCD

5.29 Syuuji Ishihara (University of Tokyo): Instability in mass-conserved reaction diffusion systems and its application to cell polarization

5.30 Naoya Tajima (RIKEN): Massless Dirac Fermions System in Organic Conductors: Transport Properties

6.2 Venyamin Berezinsky (LNGS, INFN): Ultra High Energy Cosmic Rays: from Galactic to Exragalactic Cosmic Rays

6.4 Renata Kallosh (Stanford Univ./YITP): Recent developments in N=8 supergravity

6.5 Susumu Goto (Kyoto University): Direct Interaction Approximation: Validity conditions and application to turbulence theory

6.10 Kouichi Hagino (Tohoku University): Application of semiclassical potential inversion method to multi-channel barrier penetrability

6.12 Rie Sato (ISAS/JAXA): Suzaku observation of TeV blazar 1ES 1218+304: clues on particle acceleration in an extreme TeV blazar

6.12 Takeaki Araki (Kyoto University): Dynamics of colloidal particles in soft matters

6.17 Carlos Bertulani (Texas A & M University): New Challenges in Nuclear Astrophysics

6.19 Fusao Oka (Kyoto University): Constitutive model for soils and its application

6.20 Philippe Lecheminant (Université de Cergy-Pontoise): Trions and Quartet condensates in multicomponent fermionic cold atoms in optical lattice

6.25 Yoshifumi Hyakutake (Institute for Higher Education Research and Practice, Osaka University): Brown-Henneaux's Canonical Approach to Topologically Massive Gravity

6.25 Koichi Yazaki (Nishina Center, RIKEN, YITP): Particle Emission and Absorption in Accelerated Frames —- Unruh effect and related topics —-

6.26 Namiko Mitarai (Kyushu University): Efficient degradation and expression prioritization with small RNAs

6.26 Takaya Nozawa (Hokkaido University): Injection of dust grains from supernovae in the early universe

6.30 Pijush K. Ghosh (Visva-Bharati Univ.): Consistent Quantum Physics using pseudo-hermitian operators

7.2 Daisuke Kadoh (Center for Computational Science, University of Tsukuba): Glashow-Weinberg-Salam model on the lattice

7.3 Takenobu Nakamura (RICS, AIST): The derivation of the fluctuating nonlinear hydrodynamics equation for the underdamped Langevin equation

7.9 Kazuhiro Hikami (University of Tokyo): Topics Around Volume Conjecture

7.10 Kenichi Asano (Osaka University): Exciton Mott transition and quantum condensation in electron-hole systems

7.14 Ganapathy Baskaran (Institute of Mathematical Sciences): Quantum String Liquid and Superconductivity in doped Fe Oxypnictides

7.15 Kenji Kadota (University of Minnesota): Cosmology in warped extra dimensions

7.16 Michael Kiermaier (MIT/IPMU): One-Loop Riemann Surfaces in Schnabl Gauge

7.18 Yoshiyuki Watabiki (Tokyo Institute of Technology): Matrix Model defined by Causal Dynamical Triangulations

7.22 Piero Nicolini (Univ. of Trieste/INFN): New black hole solutions of Einstein's equation inspired by noncommutative geometry

7.23 Andreas Schäfer (University of Regensburg/YITP): YITP Colloquium: Nucleon structure from Lattice QCD

7.24 Masumi Kasai (Hirosaki University): Cosmic Acceleration? Dark Energy?? Inhomogeneous Universe!

7.24 Latham Boyle (CITA): Binary black hole merger: symmetry and the spin expansion

7.25 Massimo Tessarotto (University of Trieste): Inverse kinetic approaches for classical and quantum fluids

8.27 Luiz Agostinho Ferreira (IFSC/University of Sao Paulo): A simple formula for the conserved charges of soliton theories

8.27 Hiroto Kuninaka (Chuo University): Modelling on population migration to reproduce rank-size distribution of cities - Why does Zipf's law break down? -

8.29 Shinya Aoki (University of Tsukuba): YITP Colloquium: Determination of Nuclear Force from Lattice QCD

9.9 Alexander Lenz (University of Regensburg): New physics in $B_s - \overline{B_s}$ mixing

9.9 Vladimir Braun (University of Regensburg): Applications of Integrability in QCD

9.12 Shinji Ejiri (Brookhaven National Laboratory): Joint Seminar: Numerical study of QCD phase transition at high temperature and density

9.17 Jun Goryo (Nagoya Unviersity): Physics of Chern-Simons term in a chiral p-wave superconductor

9.25 Piet Hut (Institute for Advanced Study): GCOE/YITP Seminar: Astronomy in Virtual Worlds: from meetings to collaborations to simulations

9.25 Manolis Antonoyiannakis (American Physical Society): GCOE/YITP Colloquim: Successful Letters in Physical Review Letters: An editor's perspective

9.26 Michio Otsuki (YITP): Universally scaling in the jamming transition

10.2 Tomio Y. Petrosky (The University of Texas at Austin): Complex Eigenvalue

Problem of Liouville Operator and Kinetic Equation for Non-equilibrium Systems

10.9 Michael V. Sadovskii (Russian Academy of Sciences): Mott-Hubbard Transition and Anderson Localization: Generalized Dynamical Mean-Field Theory Approach

10.9 Masaki Iwasawa (National Astronomical Observatory of Japan): Evolution of unequal massive binary blackhole through the stellar interaction

10.9 Hiroshi Watanabe (Information Technology Center, University of Tokyo): Isothermal Dynamics and Non-Hermitian Liouville Operator

10.10 Masafumi Kurachi (YITP): A nonperturbative test of multiple M2 theory

10.23 Karlo Penc (Research Institute for Solid State Physics and Optics): YITP Colloquium: Multipolar ordering in frustrated spin models

10.24 David Berenstein (University of California, Santa Barbara): A new dimension for the AdS/CFT correspondence

10.27 Stuart Parkin (IBM Almaden Research Center): YITP Colloquium: Current induced magnetization dynamics in magnetic nanowires: challenging problems for theorists!

10.29 Masakazu Sano (Hokkaido University): Moduli fixing and T-duality in Type II brane gas models

11.6 Douglas Heggie (University of Edinburgh): GCOE/YITP Seminar: Shaping globular clusters

11.6 Robert Brandenberger (McGill University): Non-equilibrium mode-coupling theory for uniformly sheared systems

11.12 Shunsuke Teraguchi (Nagoya University): On the general action of boundary (super)string field theory

11.13 Marco Picco (LPTHE, Université Paris 6): Critical interfaces in the Random Potts model

11.19 Luigi Del Debbio (University of Edinburgh): Technicolor on the lattice

11.20 Gerhard Börner (Max-Planck-Institute for Astrophysics): Cosmological Structure Formation: The Growth and Structure of Dark Matter Halos

11.25 Roberto Emparan (Univ. of Barcelona): GCOE/YITP Seminar: Blackfolds

11.25 Frieder Lenz (Institute for Theoretical Physics III, University of Erlangen-Nürnberg): Instantons and Confinement

11.26 Tetsuji Kimura (YITP): Realization of AdS Vacua in Attractor Mechanism on Generalized Geometries

11.27 Gerasimos Rigopoulos (Universiy of Helsinki): On the Infrared Divergences of Inflationary Perturbations

12.1 Peter Petreczky (Brookhaven National Laboratory): YITP Joint Seminar: QCD Thermodynamics on the lattice with improved staggered fermions

12.5 Masaru Shibata (University of Tokyo): Status of numerical relativity

12.10 Tetsufumi Hirano (University of Tokyo): Dynamical Modeling of Heavy Ion Collisions

12.11 Martin Luc Rosinberg (LPTMC, Universite Pierre et Marie Curie): Hysteresis and complexity in externally driven glassy systems

12.17 Takashi Umeda (YITP/University of Tsukuba): A new approach to QCD Thermodynamics on the lattice

12.24 M. Semenov-Tian-Shansky (University of Bourgogne/Steklov Mathematical Inst.): Poisson Lie Groups and an extension of the Virasoro algebra

1.5 Antonio De Felice (University of Louvain): Trapping gravitons on the core of a hypermonopole

1.6 Yuji Tachikawa (Institute for Advanced Study): GCOE/YITP Seminar: A counterexample to the "a-theorem"

1.7 Takahiro Tanaka (YITP): YITP Joint Seminar: Gravity in Braneworld

1.14 Mirzayusuf Musakhanov (Uzbekistan National University): GCOE/YITP Seminar: Low Energy Constants of the Chiral Perturbation Theory from the QCD instanton vacuum model

1.15 Piet Hut (Institute for Advanced Study): GCOE/YITP Seminar: Knowledge of Knowledge: Widely Interdisciplinary Research

1.21 Alexander A. Belavin (Landau Institute for Teoretical Physics): Correlation numbers in Minimal Liouville Gravity and Matrix models

1.23 Mohab Abou Zeid (Queen Mary, University of London): Twistor Strings, Pure Spinors, and N=2 Superstrings

1.28 Cedric Deffayet (CNRS/University of Paris 7): The Vainshtein mechanism in the Decoupling Limit of massive gravity

1.28 Robert H. Brandenberger (McGill University): New Constraints on the Tension of Cosmic Strings

1.28 Akinobu Dote (IPNS/KEK): GCOE/YITP Seminar: Variational calculation of the K-pp system with chiral dynamics

1.29 Robert H. Brandenberger (McGill University): Cosmology of the Lee-Wick Model

2.4 Peter Prelovsek (Jozef Stefan Inst. /University of Ljubljana): Thermal and spin transport in disordered spin chains

2.4 Antonio Masiero (University of Padua): YITP Colloquium: The Flavor Bet on New Physics

2.10 Bongsoo Kim (Changwon National University): Weak coupling expansion for the Kawasaki-Dean equation: nonperturbative treatment of thermal noise and a correction to MCT

2.10 Yoshitaka Hatta (University of Tsukuba): e+e- annihilation and jets in QCD and gauge/string duality

2.10 Chong Song-Ho (Institute for Molecular Science): Generalized Green-Kubo formulae for uniformly sheared dissipative systems

2.12 Michio Ohtsuki (Aoyama Gakuin University): Theory of scaling laws near the jamming transition point

2.13 Koji Hashimoto (RIKEN): Nuclear Force from String Theory

2.20 Hiroyuki Yamase (National Institute for Materials Science): Self-masking of a Pomeranchuk instability in layered materials

2.24 Shinji Mukoyama (IPMU, University of Tokyo): Phenomenological and conceptual issues with ghost condensate

2.25 Namiko Mitarai (Kyushu University): Effect of collision and traffic jam of ribosomes on translation process

3.5 Sungjay Lee (KIAS): YITP Seminar Series: Nonrelativistic ABJM model: a first step to NR holography

3.5 Hiroaki Kanno (Nagoya University): YITP Seminar Series: Macdonald operator and the refined topological vertex

3.5 Masahide Manabe (Nagoya University): YITP Seminar Series: Topological strings on local toric del Pezzo surfaces via remodeling the B-model

3.6 Kazutoshi Ohta (Tohoku University): YITP Seminar Series: Deformed Matrix Model and Hilbert Series

3.6 Masato Taki (University of Tokyo): YITP Seminar Series: Topological Strings and D-modules

3.6 Hiroyuki Fuji (Nagoya University): YITP Seminar Series: On computation of disk instantons -B-model approach-

3.6 Masao Jinzenji (Hokkaido University): YITP Seminar Series: Applications of Residue Integral Representation of Virtual Structure

3.6 Masahiko Machida (Japan Atomic Energy Agency): Electronic, lattice, and band structures of iron-arsenic based superconductors from first principle calculations

3.13 Eiji Kaneshita (Argonne National Laboratory): Study of Pressure Effects on Striped Nickelates: Spin-State transition and Phonon Excitations

3.18 Natsuhiko Yoshinaga (Unviersity of Tokyo): Thermophoresis and induced flow near surface under temperature gradient

3.23 Pradip Kumar Sahu (Institute of Physics, Bhubaneswar): Identifying jets in heavy-ion collision

2.5 Visitors (2008)

Participants of various workshops and conferences are not included in the following lists.

Atom-type Visitors

Philipp Gubler (N)
TIT
2008.6.23 – 7.23

Yasuhiro Nakayama (C)
Niigata Univ.
2008.10.27 – 11.26

Akihiro Nishiyama (N)
Univ. of Tokyo
2008.11.25 – 12.25

Masahiro Shimano (A)
Rikkyo Univ.
2008.12.9 – 12.22

Short Visitors

Winitzki, Sergei (A)
Ludwig-Maximilians University
2008.4.1 — 2008.4.14

Vanchurin, Vitaly (A)
Ludwig-maximilians University
2008.4.1 — 2008.4.20

Linde, Andrei (A)
Stanford University
2008.4.1 — 2008.6.30

Yamazaki, Masahito (E)
University of Tokyo
2008.4.15 — 2008.5.15

Hanayama, Hidekazu (A)
National Astronomical Observatory of Japan / University of Tokyo
2008.5.7 — 2008.5.20

Katsuragi, Hiroaki (C)
Kyushu University
2008.5.8 — 2008.5.9

Okuyama, Kazumi (E)
Shinshu University
2008.5.9 — 2008.5.10

Shimizu, Yuji (E)
International Christian University
2008.5.12 — 2008.5.14

Nakamura, Shuntaro (E)
Tohoku University
2008.5.13 — 2008.5.15

Mueller, Ewald (A)
Max-Planck Institute for Astrophysics
2008.5.16 — 2008.5.20

Lin, C.-J. David (E)
National Chiao-Tung University
2008.5.18 — 2008.5.31

Lemoine, Martin (A)
Institut d' Astrophysique de Paris
2008.5.19 — 2008.5.20

Jhingan, Sanjay (A)
Center for Theoretical Physics, Jamia Millia Islamia, New Delhi
2008.5.20 — 2008.5.27

Ono, Masaomi (A)
Kyushu University
2008.5.21 — 2008.5.23

Afanasjev, Anatoli (N)
Mississippi State University
2008.5.22 — 2008.5.25

Ishihara, Syuuji (C)
University of Tokyo
2008.5.28 — 2008.5.29

Tajima, Naoya (C)
RIKEN
2008.5.30 — 2008.5.30

Berezinsky, Venyamin (A)
INFN
2008.6.2 — 2008.6.3

Hirenzaki, Satoru (N)
Nara Women's Univ
2008.6.3 — 2008.6.3

Yamagata, Junko (N)
Nara Women's Univ
2008.6.3 — 2008.6.3

Nagahiro, Hideko (N)
RCNP
2008.6.3 — 2008.6.3

Hagino, Kouichi (N)
Tohoku University
2008.6.9 — 2008.6.10

Imamura, Yosuke (E)
University of Tokyo
2008.6.9 — 2008.6.14

Sato, Rie (A)
ISAS/JAXA
2008.6.12 — 2008.6.13

Ho, Choon-Lin (E)
Tamkang University
2008.6.12 — 2008.9.11

Hashimoto, Koji (E)
RIKEN Wako Institute
2008.6.13 — 2008.6.14

Bertulani, Carlos (N)
Texas A& M University
2008.6.15 — 2008.6.18

Kurita, Yasunari (C)
Kwansei Gakuin University
2008.6.18 — 2008.6.18

Lecheminant, Philippe (C)
Universite de Cergy-Pontoise
2008.6.19 — 2008.6.28

Urakawa, Yuko (A)
Graduate School of Advanced Science and Engineering, Waseda University
2008.6.23 — 2008.7.5

Gubler, Philipp (N)
Tokyo Institute of Technology
2008.6.23 — 2008.7.23

Nozawa, Takaya (A)
Hokkaido University
2008.6.25 — 2008.6.27

Mitarai, Namiko (C)
Kyushu University
2008.6.26 — 2008.6.26

Ghosh, Pijush K. (E)
Visva-Bharati University, India
2008.6.30 — 2008.7.5

Matsumiya, Hiroshi (N)
Hokkaido University
2008.7.1 — 2008.7.2

Baskaran, Ganapathy (C)
Institute of Mathematical Sciences
2008.7.10 — 2008.7.16

Kadota, Kenji (A)
University of Minnesota
2008.7.13 — 2008.7.16

Saito, Keiji (C)
Graduate School of Science, Univ. Tokyo
2008.7.15 — 2008.7.16

Kiermaier, Michael (E)
MIT/IPMU
2008.7.15 — 2008.7.20

Dorey, Patrick (E)
Durham University
2008.7.15 — 2008.7.31

Lee, Jen-Chi (E)
National Chiao-Tung University
2008.7.15 — 2008.8.15

Khare, Avinash (E)
Institute of Physics, Bhubaneswar
2008.7.20 — 2008.7.26

Francoise, Jean-Pierre (E)
Univ. Pierre et Marie Curie
2008.7.22 — 2008.7.28

Khastgir, S. Pratik (E)
Indian Institute of Technology, Kharagpur
2008.7.22 — 2008.7.26

Hou, Bo-Yu (E)
Northwest University
2008.7.22 — 2008.7.26

Corrigan, Edward (E)
Durham University
2008.7.22 — 2008.8.7

Inozemtsev, Vladimir (E)
Joint Institute for Nuclear Research, Dubna
2008.7.23 — 2008.7.28

Kawai, Shinsuke (E)
University of Helsinki
2008.7.23 — 2008.8.4

Minamitsuji, Masato (A)
Ludwig Maximilian University
2008.7.25 — 2008.8.6

Strickland, Michael (N)
Johann Wolfgang Goethe University
2008.7.31 — 2008.8.15

Nara, Yasushi (N)
Akita International University
2008.8.4 — 2008.8.16

Mizukawa, Rei (N)
Hokkaido University
2008.8.4 — 2008.8.21

Sato, Matsuo (E)
Hirosaki University
2008.8.4 — 2008.9.12

Fries, Rainer (N)
Texas A&M University
2008.8.5 — 2008.8.19

Mueller, Berndt (N)
Duke University
2008.8.7 — 2008.8.23

Schaefer, Thomas (N)
North Carolina State University
2008.8.9 — 2008.8.17

Natsuume, Makoto (N)
KEK
2008.8.10 — 2008.8.15

Hirano, Tetsufumi (N)
University of Tokyo
2008.8.10 — 2008.8.21

Matsufuru, Hideo (E)
KEK
2008.8.11 — 2008.8.13

Ohtani, Munehisa (N)
Kyorin University
2008.8.12 — 2008.8.15

Kawanaka, Norita (A)
University of Tokyo
2008.8.19 — 2008.8.21

Hasebe, Kazuki (E)
Takuma National College of Technology
2008.8.22 — 2008.8.29

Ferreira, Luiz Agostinho (E)
Instituto de Fisica de Sao Carlos/University de Sao Paulo
2008.8.26 — 2008.9.1

Toda, Kouichi (E)
Toyama Prefectural University
2008.8.26 — 2008.9.1

Matsueda, Hiroaki (C)
Sendai National College of Technology
2008.9.1 — 2008.9.7

Hut, Piet (A)
Institute for Advance Study, Princeton
2008.9.1 — 2008.9.30

Kotera, Kumiko (A)
Institut d'Astrophysique de Paris
2008.9.5 — 2008.10.4

Kanno, Hiroaki (E)
Nagoya University
2008.9.8 — 2008.9.10

Odake, Satoru (E)
Shinshu University
2008.9.8 — 2008.9.13

Ohkubo, Shigeo (N)
Kochi Women's University
2008.9.8 — 2008.9.17

Matsufuru, Hideo (E)
KEK
2008.9.18 — 2008.9.19

Seki, Shigenori (E)
Tel Aviv University
2008.10.1 — 2008.10.16

Petrosky, Tomio (C)
University of Texas, Austin
2008.10.1 — 2008.10.31

Romhanyi, Judit (C)
Research Institute for Solid State Physics and Optics, Budapest
2008.10.1 — 2008.12.29

Hosomichi, Kazuo (E)
KIAS
2008.10.6 — 2008.10.17

Schuck, Peter (N)
IPN-Orsay
2008.10.6 — 2008.10.24

Kato, Kiyoshi (N)
Hokkaido University
2008.10.11 — 2008.10.15

Hatano, Naomichi (C)
University of Tokyo
2008.10.12 — 2008.10.17

Kawabata, Takahiro (N)
The University of Tokyo
2008.10.13 — 2008.10.17

Takashina, Masaaki (N)
Osaka University
2008.10.13 — 2008.10.17

Tay, Buang Ann (C)
Universiti Putra Malaysia
2008.10.13 — 2008.10.26

Funaki, Yasuro (N)
RIKEN
2008.10.14 — 2008.10.15

Wakasa, Tomotsugu (N)
Kyushu University
2008.10.14 — 2008.10.15

Horiuchi, Hisashi (N)
Osaka University
2008.10.14 — 2008.10.17

Tanaka, Satoshi (C)
Osaka Prefecture University
2008.10.15 — 2008.10.17

Roepke, Gerd (N)
Rostock University
2008.10.15 — 2008.10.22

Aoyama, Shigeyoshi (N)
Niigata University
2008.10.16 — 2008.10.21

Ishibashi, Akihiro (A)
KEK
2008.10.16 — 2008.10.21

Barsegov, Valeri (C)
University of Massachusetts Lowell
2008.10.16 — 2008.10.27

Funaki, Yasuro (N)
RIKEN
2008.10.17 — 2008.10.24

Tohsaki, Akihiro (N)
Osaka University
2008.10.17 — 2008.10.24

Charmousis, Christos (A)
University Paris 11
2008.10.17 — 2008.11.4

Hagino, Kouichi (N)
Tohoku University
2008.10.18 — 2008.10.21

Yamada, Taiichi (N)
Kanto Gakuin University
2008.10.18 — 2008.10.22

Suzuki, Toru (N)
Tokyo Metropolitan University
2008.10.19 — 2008.10.22

Khoa, Tao Tien (N)
Institute for Nuclear Science & Technique
2008.10.19 — 2008.10.24

Neff, Thomas (N)
GSI
2008.10.19 — 2008.10.28

Sagawa, Hiroyuki (N)
Aizu University
2008.10.20 — 2008.10.21

Takashina, Masaaki (N)
Osaka University
2008.10.20 — 2008.10.24

Horiuchi, Hisashi (N)
Osaka Univeristy
2008.10.20 — 2008.10.24

Ito, Makoto (N)
RIKEN
2008.10.20 — 2008.10.24

Matsuo, Masayuki (N)
Niigata University
2008.10.21 — 2008.10.23

Tanaka, Satoshi (C)
Osaka Prefecture University
2008.10.22 — 2008.10.24

Hatano, Naomichi (C)
University of Tokyo
2008.10.22 — 2008.10.24

Nakamura, Takashi (N)
Tokyo Institute of Technology
2008.10.23 — 2008.10.24

Li, Chun Biu (C)
Hokkaido University
2008.10.23 — 2008.10.25

Chadan, Khosrow (E)
University Paris-Sud
2008.10.25 — 2008.11.3

Ishibashi, Akihiro (A)
KEK
2008.10.27 — 2008.11.7

Nakayama, Yasuhiro (C)
Niigata University
2008.10.27 — 2008.11.26

Miyazawa, Hironari (E)
University of Tokyo
2008.11.2 — 2008.11.3

Del-Debbio, Luigi (E)
Univeristy of Edinburgh
2008.11.18 — 2008.11.21

Lin, C.-J. David (E)
National Chiao-Tung Univeristy
2008.11.18 — 2008.11.22

Okazaki, Atsuo (A)
Hokkai-Gakuen University
2008.11.20 — 2008.11.24

Taniguchi, Yasutaka (N)
Osaka University
2008.11.21 — 2008.11.21

Naito, Tsuguya (A)
Yamanashi Gakuin University
2008.11.21 — 2008.11.23

Yoo, Chul-Moon (A)
Asia Pacific Center for Theoretical Physics
2008.11.21 — 2008.11.27

Kawachi, Akiko (A)
Tokai University
2008.11.22 — 2008.11.24

Emparan, Roberto (A)
University of Barcelona
2008.11.22 — 2008.11.26

Deruelle, Nathalie (A)
IHES
2008.11.23 — 2008.12.21

Nishiyama, Akihiro (N)
Tokyo University
2008.11.25 — 2008.12.25

Aoki, Kenichiro (E)
Keio University
2008.12.1 — 2008.12.4

Clunan, Timothy (A)
Cambridge University
2008.12.2 — 2009.2.28

Shibata, Masaru (A)
University of Tokyo
2008.12.4 — 2008.12.5

Shimano, Masahiro (A)
Rikkyo University, Inst. of Theor. Phys.
2008.12.9 — 2008.12.22

Tetsufumi Hirano (N)
University of Tokyo
2008.12.10 — 2008.12.11

Kokalj, Jure (C)
Josef Stefan Institute, Slovenia
2008.12.14 — 2008.12.22

Stewart, Ewan (A)
KAIST
2008.12.20 — 2009.1.24

Lee, Hyung-Joo (A)
KAIST
2008.12.21 — 2009.1.24

Hwang, Dong Il (A)
KAIST
2008.12.21 — 2009.1.24

Hasebe, Kazuki (C)
Takuma National College of Technology
2008.12.24 — 2008.12.27

Lee, Young Jae (A)
KAIST
2009.1.2 — 2009.2.6

De Felice, Antonio (A)
University of Louvain
2009.1.5 — 2009.1.6

Tachikawa, Yuji (E)
Institute for Advanced Study, Princeton
2009.1.5 — 2009.1.7

Yoo, Chul-Moon (A)
Asia Pacific Center for Theoretical Physics
2009.1.5 — 2009.1.9

Kohri, Kazunori (A)
Lancaster University
2009.1.5 — 2009.1.9

Yokoyama, Shuichiro (A)
Nagoya University
2009.1.6 — 2009.1.10

Musakhanov, Mirzayusuf (N)
Uzbekistan National University
2009.1.7 — 2009.1.22

Takayanagi, Tadashi (E)
IPMU
2009.1.9 — 2009.1.23

Yamawaki, Koichi (E)
Nagoya University
2009.1.9 — 2009.1.25

Kim, Hyun-Chul (N)
Inha University
2009.1.13 — 2009.1.16

Tsutsui, Kenji (C)
JAEA
2009.1.14 — 2009.1.15

Mori, Michiyasu (C)
IMR, Tohoku University
2009.1.14 — 2009.1.17

Toda, Kouichi (E)
Toyama Prefectural University
2009.1.19 — 2009.1.28

Abou Zeid, Mohab (E)
Queen Mary, University of London
2009.1.21 — 2009.2.7

Dote, Akinobu (N)
KEK
2009.1.25 — 2009.1.31

Deffayet, Cedric (A)
APC Lab, Univ. Paris VII - Denis Diderot
2009.1.27 — 2009.1.29

Brandenberger, Robert (A)
McGill University
2009.1.27 — 2009.1.31

Shimano, Masahiro (A)
Rikkyo University
2009.2.1 — 2009.2.6

Hyodo, Tetsuo (N)
TITEC
2009.2.2 — 2009.2.4

Prelovsek, Peter (C)
Jozef Stefan Institute
2009.2.2 — 2009.2.7

Hatano, Naomichi (C)
University of Tokyo
2009.2.3 — 2009.2.5

Kanki, Kazuki (C)
Osaka Prefecture University
2009.2.4 — 2009.2.5

Nakamura, Hiroaki (C)
National Institutes of Natural Science
2009.2.4 — 2009.2.5

Petrosky, Tomio (C)
University of Texas, Austin
2009.2.4 — 2009.2.5

Tanaka, Satoshi (C)
Osaka Prefecture University
2009.2.4 — 2009.2.5

Otsuki, Michio (C)
Aoyama University
2009.2.9 — 2009.2.9

Hatta, Yoshitaka (N)
Graduate School of Pure and Applied Science, Univ. Tsukuba
2009.2.9 — 2009.2.10

Chong, Song-Ho (C)
Institute for Molecular Science
2009.2.9 — 2009.2.13

Kim, Bongsoo (C)
Changwon National University
2009.2.9 — 2009.2.13

Zaballa, Ignacio (A)
KIAS
2009.2.9 — 2009.2.16

Ohtsuki, Michio (C)
Aoyama University
2009.2.12 — 2009.2.13

Fujii, Hirotsugu (N)
University of Tokyo
2009.2.12 — 2009.2.20

Hikami, Kazuhiro (E)
Naruto University of Education
2009.2.19 — 2009.2.20

Yamase, Hiroyuki (C)
National Institute for Materials Science
2009.2.20 — 2009.2.21

Mukohyama, Shinji (A)
IPMU, Univ. Tokyo
2009.2.20 — 2009.2.24

Lee, Sangjay (E)
KIAS
2009.3.1 — 2009.3.10

Sahu, Pradip Kumar (N)
Institute of Physics, Bhubaneswar
2009.3.1 — 2009.3.30

Kanno, Hiroaki (E)
Nagoya University
2009.3.2 — 2009.3.6

Jinzenji, Masao (E)
Hokkaido University
2009.3.4 — 2009.3.7

Taki, Masato (E)
University of Tokyo
2009.3.5 — 2009.3.6

Fuji, Hiroyuki (E)
Nagoya University
2009.3.5 — 2009.3.6

Manabe, Masahide (E)
Nagoya University
2009.3.5 — 2009.3.6

Ohta, Kazutoshi (E)
Tohoku University
2009.3.5 — 2009.3.7

Mueller, Berndt (N)
Duke University
2009.3.9 — 2009.3.13

Tsubakihara, Kohsuke (N)
Hokkaido University
2009.3.23 — 2009.3.24

Lin, C.-J. David (E)
National Chiao-Tung University
2009.3.30 — 2009.3.30

In the above lists, the symbols A, C, E and N in the parentheses are the following abbreviations of research fields:

A: Astrophysics and Cosmology
C: Condensed Matter and Statistical Physics
E: Elementary Particle Theory
N: Nuclear Physics Theory

Chapter 3

Workshops and Conferences

3.1 International Workshops and Conferences

Since 1978, a series of international physics workshops, called *Yukawa International Seminar (YKIS)* are held annually or bi-annually. *The Nishinomiya Yukawa Memorial Project* was initiated by Nishinomiya city where the late Prof. Hideki Yukawa lived when he wrote his famous papers on the meson theory. As one of the major programs of this project, an international symposium open to public was held every year in Nishinomiya city, and its post/pre-workshop held at YITP. In recent years both the Nishinomiya Yukawa Symposium and its post/pre-workshops are held at YITP, Kyoto.

As of the academic year 2007, Yukawa Institute for Theoretical Physics launched a new five-year project, "*Yukawa International Program for Quark-Hadron Sciences* (YIPQS)." A few research topics are selected each year and a long-term workshop focused on each topic, extending over a period of a few months, is organized by inviting leading experts from the world. Emphasis is laid on fostering fruitful collaboration among the workshop participants. See page 20 for details.

In addition to these regular annual conferences, many international workshops and conferences of various sizes and durations from several days to more than one month are held every year.

Here is a list of main international workshops and conferences held in the academic year 2008.

Yukawa International Seminar (YKIS2008)

16th YKIS2008 : Particle Physics beyond the Standard Model

Jan. 16 – Mar 25, 2009, Chaired by Taichiro Kugo, 65 participants (21 from abroad)
For details see http://www2.yukawa.kyoto-u.ac.jp/~ppbsm/index.html

Nishinomiya-Yukawa Symposium 2008

The 23rd Nishinomiya-Yukawa Memorial International Workshop "Spin Transport in Condensed Matter"

Oct 27 - Nov 28, 2008, Chaired by Hiroshi Kohno, 141 participants (47 from overseas)
For details, see http://www.stcm_workshop.mp.es.osaka-u.ac.jp/

3.2 YITP Workshops

YITP workshops are one of the main activities of Yukawa Institute. The aim of them is to open new research fields and stimulate nationwide collaborations. Workshop plans can be proposed by any researcher and are approved by the Committee on Research Projects of the Institute. Small workshops, summer schools and regional schools to educate young researchers are positively supported.
In the past 5 years, more than 20 workshops are held each year with 1500 strong participants visiting YITP. The list of the workshops together with the number of participants for the last academic year is given below.

▷ 2008.4.1 — 2009.3.31

Here is the list of workshops with the dates, the names of organizers, the number of participants, the proceedings and the url's.

YITP-W-08-01
Topological aspects of sikud state physics, Jun 23 - Jun 25, 2008. M. Kohmoto, M. Oshikawa, K. Totsuka, 79-participants, Bussei Kenkyuu 91-6
http://www.issp.u-tokyo.ac.jp/public/tassp/index.html

YITP-W-08-02
Molecular Structure and Low-Energy Reactions in Nuclear Systems, Jul 2 - Jul 4, 2008. N. Itagaki, Y. Taniguchi, S. Aoyama, M. Ito, K. Ogata, K. Yabana, M. Takashina, Y. En'yo, K. Kato, K. Hagino, T. Wada, 50-participants,
http://www2.yukawa.kyoto-u.ac.jp/˜moslere/

YITP-W-08-03
Summer School on Astronomy and Astrophysics 2008, Jul 27 - Jul 30, 2008. D. Namekata, Y. Chinone, D. Nitta, H. Nishitani, K. Numata, K. Hagiwara, H. Hayashi, Y. Watanabe, H. Yajima, S. Isii, S. Inoue, 356-participants,
http://www.astro-wakate.org/ss2008/

YITP-W-08-04
Development of Quantum Field Theory and String Theory, Jul 28 - Aug 1, 2008. S. Sugimoto, M. Sakamoto, T. Takayanagi, Y. Satoh, S. Terashima, M. Kato, T. Takahashi, N. Ohta, K. Hashimoto, M. Hamanaka, Y. Imamura, H. Kunitomo, 135-participants, Soryuushiron Kenkyuu 117-1
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2008/yitp-w-08-04/

YITP-W-08-05
Quantum Physics in non-uniform superconducting and superfluid systems, Jul 31 - Aug 2, 2008. Y. Asano, Y. Tanaka, K. Miyake, T. Tohyama, Y. Kato, K. Nagai, 59-participants, Bussei Kenkyuu 91-3
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2008/yitp-w-08-05

YITP-W-08-06
The 53th Summer Seminar for young researchers of condensed-matter physics, Aug 7 - Aug 11, 2008. T. Omi, T. Mori, K. Kurihara, K. Noda, S. Kushida, K. Inokuchi, M. Kuroda, K. Goto, M. Hirata, K. Saito, T. Kajiyama, A. Saeki, Y. Ando, H. Kim, Y. Nakata, 185-participants, Bussei Kenkyuu 91-5
http://ss2008.t.u-tokyo.ac.jp/

YITP-W-08-07
YONUPA Summer School 2008, Aug 19 - Aug 24, 2008. S. Shiba, N. Yamamoto, N. Takahashi, H. Imazato, N. Fukui, H. Inoue, T. Houri, M. Ohta, N. Ogawa, S. Ohya, T. Sumi, T. Sekihara, J.W. Lee, H. Yoshimoto, K. Nagao, K. Haba , 280-participants,

YITP-W-08-08
Knot and soft-matter physics: topology of polymers and related topics in physics, mathematics and biology , Aug 26 - Aug 29, 2008. T. Deguchi, M. Imai, H. Takano, K. Shimokawa, K. Tsurusaki, A. Stasiak, 63-participants, Bussei Kenkyuu 92-1
http://www.phys.ocha.ac.jp/deguchilab/knot2008/

YITP-W-08-09
Thermal Quantum Field Theories and Their

Applications, Sep 3 - Sep 5, 2008. S. Muroya, M. Mine, M. Okumura, K. Iida, T. Inagaki, M. Asakawa, C. Nonaka, S. Abe, M. Tachibana, M. Sakagami, 89-participants, Soryuushiron Kenkyuu 116-6
http://www.riise.hiroshima-u.ac.jp/TQFT/

YITP-W-08-10
Workshop on Maximum Entropy Production: Earth, Life and Physical Approaches, Sep 10 - Sep 12, 2008. S. Shimokawa, R.D. Lorenz, Y. Sawada, H. Ozawa, 19-participants,
http://mizu.bosai.go.jp/MEP/wiki.cgi

YITP-W-08-11
What is Creativity? Emergent Phenomena in Complex Adaptive Systems, Oct 20 - Oct 22, 2008. G. Taga, T. Nishihara, K. Nishimura, Y. Gunji, S. Noma, M. Murase, Y. Aizawa, Y. Miyake, K. Ebina, 64-participants, Bussei Kenkyuu 91-4
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2008/yitp-w-08-11/

YITP-W-08-12
International Conference on Unifying Concepts in Glass Physics IV, Nov 25 - Nov 28, 2008. R. Yamamoto, F. Sciortino, S. Sastry, D. Reichman, T. Araki, S. Franz, K. Fukao, K. Hukushima T. Odagaki, 151-participants, Bussei Kenkyuu 91-6
http://www-tph.cheme.kyoto-u.ac.jp/UCGP2008/

YITP-W-08-13
Japan-France Joint Seminar on Frontier of Glassy Physics, Nov 19 - Nov 22, 2008. L. Cugliandolo, M. Picco, H. Wada, H. Hayakawa, T. Odagaki, T. Araki, 58-participants,
http://www2.yukawa.kyoto-u.ac.jp/˜nichifut/

YITP-W-08-14
Recent Progress in Density Matrix Renormalization Group, Dec 16 - Dec 17, 2008. H. Matsueda, M. Machida, T. Tohyama, N. Shibata, 26-participants, Bussei Kenkyuu 91-6
http://www2.yukawa.kyoto-u.ac.jp/˜tohyama/DMRG_WS/index.html

YITP-W-08-15
Massive Black Hole Astronomy: the latest trends and issues , Jan 20 - Jan 22, 2009. S. Mineshige, T.G. Tsuru, K. Makishima, K. Hayasaki, N. Nakai, S. Kameno, Y. Ueda, Y. Hagiwara, M. Honma, N. Gouda, M. Umemura, A. Doi, H. Sudoh, 91-participants,
http://www2.yukawa.kyoto-u.ac.jp/˜smbh2009/program.pdf

YITP-W-08-16
16th YKIS Conference "Progress in Particle Physics 2008", Feb 16 - Feb 19, 2009. K. Ogure, 70-participants, Soryuushiron Kenkyuu 117-3
http://www2.yukawa.kyoto-u.ac.jp/˜pppconf/index.html

3.3 Regional Schools supported by YITP

▷ 2008.4.1—2009.3.31

Here is the list of the Regional Schools with the dates, the place, the name(s) of the main invited Lecturer(s) and the participating Universities.

YITP-S-08-01
The 36th Hokuriku-Shinetsu Particle Theory Group Meeting, May 23 - May 25, 2008, National Tateyama Youth Outdoor Learning Center.
Yutaka Hosotani (Osaka U.)
Niigata Univ., Toyama Univ., Kanazawa Univ.

YITP-S-08-02
Chubu Summer School 2008, Aug 25 - Aug 28, 2008, Yamanakako Seminar House,Tokai University.
Masahiro Kawasaki (U. of Tokyo)
Shizuoka Univ., Shinshuu Univ., Tokai Univ.

YITP-S-08-03
13th Niigata-Yamagata School, Nov 7 - Nov 9, 2008, National Bandai Youth Friendship Center.
Shigeki Matsumoto (Toyama Univ.)
Niigata Univ., Yamagata Univ., Ohu Univ., Toyama Univ., Aizu Univ., Joetsu Univ.

YITP-S-08-04
the 31th Shikoku Seminar, Dec 20 - Dec 21, 2008, Ehime University.
Shigeki Sugimoto (IPMU)
Ehime Univ., Kochi Univ., Tokushima Univ.

YITP-S-08-05
Sapporo Winter School, Jan 8 - Jan 9, 2009, Hokkaido University.
Koji Hashimoto (RIKEN)
Hokkaido Univ., Kushiro Nat.Coll. of Tech.,

YITP-S-08-06
21th Workshop in Hokkaido Nuclear Theory Group, Feb 7 - Feb 10, 2009, Hokkaido University.
Masanobu Yahiro (Kyushu Univ.)
Hokkaido Univ., Hokusei Gakuen Univ., Kitami Inst. Tech.

YITP-S-08-07
Shinshu Winter School, Mar 3 - Mar 8, 2009, Shiga Heights Villa, Ochanomizu Univ.
Shigeru Yamashita (Nara Inst. Sci.& Tech), Noriyoshi Ishii (Tsukuba Univ.)
Kanazawa Univ., Toyama Univ., Shinshu Univ., Niigata Univ.